Engineering Library.

FEB 16 1927

"THE ENGINEER," JANUARY 28 1927.

With METALLURGICAL SUPPLEMENT.

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXLIII.—No. 3707] LONDON: FRIDAY EVENING, JANUARY 28, 1927 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Sale by Tender.

TENDERS are INVITED for the PURCHASE of TWO LIFTS, complete with 1½ H.P. Motors, 400 volts, D.C. controller, with driving gear, weights, ropes, runners, &c.

The lifts were made by the Medway Safety Lift Co. They are lying at the London, S.E., District Post Office and may be viewed by arrangement. (Telephone, Clerkenwell 9001, Extension 89.)

Forms of Tender, containing all particulars, can be obtained on application to the CONTROLLER, Post Office Stores Department, Accounts Section, Studd-street, N. 1.

Tenders will be received until 10 a.m. on Friday, the 4th February.

The Postmaster-General does not bind himself to accept the highest or any Tender.

BY ORDER OF THE POSTMASTER-GENERAL.
General Post Office,
January, 1927. 4605

The Director - General,

India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

1. 77,985 STEEL BEARING PLATES for B.F. 60 F.F. RAILS.
2. TWO 7-TONS STEAM TRAVELLING CRANES.

Tenders due on the 11th February, 1927, for No. 1, and on the 15th February, 1927, for No. 2

Specifications and forms of Tender obtainable from the above at a fee of 5s. per set., which will not be returned. 4626

Assistant Engineer Re-

QUIRED for the Irrigation Service of IRAQ for two years' service on probation in the first instance, with prospect of extension for 10 years. Free passages and liberal leave on full salary. Salary Rs. 850, rising to Rs. 900 a month by annual increments of Rs. 50. Candidates, preferably between 23-26 years of age, unmarried, should have passed the A.M.I.C.E. examination, have been educated at one of the leading Universities and have one or two years' practical experience since obtaining degrees.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/14691. 4606

Assistant Engineers (2)

REQUIRED by the RAILWAY DEPARTMENT of the FEDERATED MALAY STATES GOVERNMENT for four years' service, with possible extension. Salary 400 dollars, rising to 475 dollars a month by annual increments of 25 dollars a month, and thereafter, in the event of the officer being retained, rising to 500 dollars a month, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but the purchasing power of the dollar in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax is at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 30, preferably unmarried, must have received a good theoretical training, preferebly at an University or a College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtained such other diploma or distinction in engineering as the Secretary of State may decide in any particular case, or completed their articles with a Civil Engineer of good standing and have passed the examination for Associate Membership of the Institution of Civil Engineers. Should have had at least one year's practical experience of Railway Maintenance on a British Railway.—Apply at once by letter, giving brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting clearly at head of application M/15162. 4607

GOLD COAST.

Required for the

GOVERNMENT TECHNICAL SCHOOL, ACCRA, GOLD COAST, a MASTER, to give theoretical and practical instruction in the Metal Workshop and to assist in training African Technical Instructors. Candidates (age 25 to 35) must possess a technological qualification and have had workshop and teaching experience. Salary £480 per annum for first three years, then on the scale £510 by 30 to £720 per annum, three quarters provided.—Further information and forms of application are obtainable from C.A. (D), the SECRETARY, Board of Education, Whitehall, London, S.W. 1. Scottish candidates should apply to the SECRETARY (D), Scottish Education Department, Whitehall, London, S.W. 1. The list of applications will close on 14th February. 4542

The Goverment of Madras

REQUIRE the SERVICES of an ASSISTANT MECHANICAL SUPERINTENDENT for COCHIN HARBOUR WORKS. Must have had a sound practical training in a Marine Engineering Workshop and be conversant with up-to-date workshop practice and modern high-speed machines. Should also have experience of modern methods in moulding iron and brass. Sea-going experience essential. Must hold at least Second Engineer's Board of Trade Certificate. Age between 30 and 40 years.

Four years' agreement. Pay at the rate of Rs. 475, rising by annual increments of Rs. 25 to Rs. 550 per calendar month. Provident Fund. Free passages under the usual rules. Strict medical examination.

Forms of application and further particulars may be obtained, upon request by postcard, from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 19th February, 1927. 4581

Institution of Structural Engineers.

MODIFIED EXAMINATION FOR ASSOCIATE-MEMBERSHIP.

This Examination is held quarterly for candidates of and over 25 years of age having 10 years' practical experience, including time served in articles. It consists of a problem in design with a little additional work, which is carried out by the candidate at his own home. The NEXT EXAMINATION will be held on FEBRUARY 19th, and entries should reach me before February 14th. Syllabus and full particulars from the under-noted.

MAURICE G. KIDDY, F.I.S.A.,
Secretary.
10, Upper Belgrave-street, S.W. 1. 4479

The Engineer

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PUBLIC NOTICES

Crystal Palace School of Practical Engineering.

Founded 1872.

MECHANICAL AND CIVIL ENGINEERING DIVISIONS.

PRESIDENT : J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL : MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors.
Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 4347

Northampton Polytechnic Institute.

ST. JOHN-STREET, E.C. 1.

A WORKS SUPERINTENDENT is REQUIRED, qualified to take charge of the maintenance of the building, including Gas, Water, Heating and Lighting Installations, and to superintend the staff employed. The salary payable will depend upon qualifications and experience, but will not exceed £325 per annum.

Candidates must be competent practical engineers and should have had experience of Heating and Electrical Installations and of Building Maintenance.

Applications, addressed to the PRINCIPAL, should be made in writing before January 31st. 4589

City and County of Bristol.

PORTISHEAD GENERATING STATION.

The Electrical Committee of the Bristol Corporation are prepared to receive TENDERS for the SUPPLY, DELIVERY, ERECTION, and SETTING to WORK at the new PORTISHEAD GENERATING STATION of the following PLANT :—

SECTION 1.—COAL and ASH-HANDLING PLANT and RAILWAY SIDINGS.
SECTION 2.—CIRCULATING WATER SCREENING PLANT.

Copies of the specifications and form of Tender may be obtained from the undersigned on payment of a deposit of Two Guineas for each section, which will be refunded on receipt of a bona fide Tender. Additional copies of each specification may be obtained at the rate of 10s. 6d. per copy.

Tenders, sealed, endorsed and addressed to the undersigned, must be delivered in the special envelope issued with the specification by 10 a.m. on Friday, 18th February, 1927.

The lowest or any Tender will not necessarily be accepted.

H. FARADAY PROCTOR,
M.I.E.E., M. Inst. C.E.,
Chief Engineer and General Manager.
Electricity Offices,
Colston-avenue, Bristol. 4586

PUBLIC NOTICES

B.B. and C.I. Railway Company.

The Directors are prepared to accept up to Noon on Wednesday, 16th February, TENDERS for the SUPPLY of :—

(1) LOCOMOTIVE BOILERS ;

and up to 2.30 p.m. on Wednesday, 9th February, TENDERS for the SUPPLY of :—

(2) METALS.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of £1 each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.
Offices : The White Mansion,
91, Petty France, London, S.W. 1.
24th January, 1927. 4619

Corporation of Doncaster.

ELECTRICITY DEPARTMENT.

TENDERS are INVITED for the PURCHASE, DISMANTLING, and REMOVAL from the Generating Works, Grey Friars-road, of the following superseded PLANT :—

ONE 1250 K.V.A. TURBO-ALTERNATOR, 3-phase, 50 cycles, 3000-3300 volts, speed 3000 r.p.m.
TURBINE (Willans and Robinson), steam pressure 200 lb. per square inch. ALTERNATOR (Siemens Bros.), and with Surface Condenser and all Auxiliaries.

The plant is in first-class mechanical and electrical condition and may be inspected upon application to the undersigned, from whom any further particulars can be obtained.

S. R. WINDLE,
Borough Electrical Engineer.
Electricity Offices,
Grey Friars-road, Doncaster. 4598

Royal State Railways of Siam.

NOTICE.

Sealed TENDERS for the SUPPLY of OPEN STEEL GOODS WAGONS, B.E. 2470, will be received by the Administration of the Royal State Railways of Siam, Bankok, until Fourteen o'clock on the 3rd May, 1927, at which place and hour the Tenders will be publicly opened and read.

Blank Tender forms, general conditions, specifications and drawings may be obtained from Messrs. C. P. SANDBERG, 46, Grosvenor-gardens, London, S.W. 1, upon payment of £1 10s. per set, which sum will not be refunded.

Right is reserved to reject any or all Tenders, and to accept any Tender which is to the best interests of the Royal State Railways of Siam. 4620

PUBLIC NOTICES

City of Winchester.

MAIN DRAINAGE.
CONTRACT NO. 3.
TO CONTRACTORS.

The Corporation of Winchester are prepared to receive TENDERS for the PROVISION, LAYING, and JOINTING of about 1000 YARDS of 15in. diameter CAST IRON PUMPING MAIN; SHORT LENGTHS of 18in., 9in., and 7in. CONNECTIONS, including SLUICE VALVES, between their Pumping Station and Sewage Farm, which latter is about 2½ miles from Winchester Station, Southern Railway, and ¾ mile from Winchester Station, Great Western Railway; all in accordance with the plans and specification prepared by the Engineers, Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1.

Copies of the specification, bill of quantities and form of Tender may be obtained from, and the drawings may be seen at, the offices of the Engineers upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.

Sealed Tenders, endorsed "Winchester Drainage, Contract No. 3," addressed to the undersigned at the Guildhall, Winchester, must be received before Noon on Monday, the 14th day of February, 1927.

The Corporation do not bind themselves to accept the lowest or any Tender.

By Order,
THOMAS HOLT,
Town Clerk.
The Guildhall, Winchester. 4575

Metropolitan Borough of Shoreditch.

ELECTRICITY DEPARTMENT.

OFFERS are INVITED for the DISMANTLING and REMOVAL of TWO 1500 K.W. D.C. TURBO GENERATING SETS from the Council's Electric Generating Station, Whiston-street, Haggerston, E. 8.

Particulars of the plant and conditions of sale can be obtained from the undersigned.

W. WEEKES,
Borough Electrical Engineer.
Electricity Supply Department,
Coronet-street, Shoreditch, N. 1.
24th January, 1927. 4593

Metropolitan Borough of Shoreditch.

ELECTRICITY DEPARTMENT.

TENDERS are INVITED for the SUPPLY, DELIVERY, and ERECTION of the following PLANT, to be installed at the Council's Electric Substation, Evelyn-street, New North-road, N. 1, viz.:—

(a) ONE 1500 K.W. AUTOMATIC SUB-STATION CONVERTING EQUIPMENT.
(b) ONE 20 Tons Capacity Electrically Operated OVERHEAD TRAVELLING CRANE.

Specifications and forms of Tender will be available on the 31st January, 1927, and may be had upon application to the undersigned on payment of a deposit of One Guinea, which will be returned on receipt of a bona fide Tender.

Tenders, enclosed in a sealed envelope endorsed "Tender for Converting Plant" or "Tender for Electric Crane," as the case may be, and addressed to the Chairman and Members, Electricity Committee, must be delivered at the offices of the Electricity Supply Department, Coronet-street, Shoreditch, N. 1, not later than Noon on Wednesday, 23rd February, 1927.

Only Tenders from British firms will be considered.

The Council do not bind themselves to accept the lowest or any Tender.

W. WEEKES,
Borough Electrical Engineer.
Electricity Department,
Coronet-street, Shoreditch, N. 1.
24th January, 1927. 4594

Pontefract Corporation Water-Works.

CONTRACT NO. 3.
BORE-HOLE AT EGGBOROUGH.

The Corporation of Pontefract invite TENDERS from firms of competent Boring Contractors for PUTTING DOWN a BORE-HOLE, 36in. and 33in. diameter, to the depth of 450ft., and LINING with STEEL TUBES, at the site of their new Waterworks at Eggborough, and also MAKING a PUMPING TEST of the yield of water from the Bore-hole.

Copy of the specification and general conditions of contract and the schedule of works may be obtained from the Consulting Engineer, Mr. F. Walter Hodson, M. Inst. C.E., at Bank Chambers, Loughborough, on deposit of cheque for Five Guineas, which will be refunded to bona fide tenderers on return of the papers.

Tenders, on the form supplied, are to be sent to the undersigned not later than 20th February, 1927.

The Corporation do not bind themselves to accept the lowest or any Tender.

F. M. FARMER,
Town Clerk.
Municipal Offices, Pontefract,
22nd January, 1927. 4600

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PUBLIC NOTICES

Metropolitan Water Board.

TENDERS FOR PIPE LAYING, &c.

The Metropolitan Water Board invite TENDERS for PIPE LAYING, ALTERATIONS, and BRICKLAYERS' WORK within the areas of their Kent, Northern, Southern and Western Districts, for the period of twelve months, commencing 1st April, 1927.

Tenders must be made on the official form, which may be obtained from the Chief Engineer, Metropolitan Water Board, 173, Rosebery-avenue, E.C. 1, on and after Monday, 24th January, 1927, by personal application (Room 156) or upon forwarding a stamped addressed brief envelope.

Tenders, enclosed in sealed envelopes, addressed to the Clerk, Metropolitan Water Board, 173, Rosebery-avenue, Clerkenwell, E.C. 1, and endorsed "Tender for Pipe Laying, &c.," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Monday, the 14th February, 1927.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, Clerkenwell, E.C. 1,
13th January, 1927. 4509

Metropolitan Water Board.

TENDERS FOR THE SUPPLY OF CAST IRON PIPES, SLUICE VALVES AND HYDRANTS.

The Metropolitan Water Board invite TENDERS for the SUPPLY of the undermentioned STORES, &c., for periods of 6 or 12 months, commencing 1st April, 1927 :—

Tender No.

3. Cast Iron Pipes and Irregular Castings.

21. Sluice Valves and Spindles, Fire Hydrants, &c.

Tenders must be made on the official forms, which may be obtained from the Chief Engineer, Metropolitan Water Board, 173, Rosebery-avenue, E.C. 1, on and after Monday, 24th January, 1927, by personal application (Room 156) or upon forwarding a stamped addressed brief envelope.

Applicants should refer to the number of the Tender for which forms are required.

Tenders, enclosed in sealed envelopes addressed to "The Clerk," Metropolitan Water Board, 173, Rosebery-avenue, E.C. 1, and endorsed in the manner indicated in the form of Tender, must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Monday, 14th February, 1927.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
13th January, 1927. 4508

Spalding Urban District Council.

SEWERAGE AND SEWAGE DISPOSAL SCHEME.
CONTRACT NO. 2.
PUMPING PLANT.

The above Council invite TENDERS for the SUPPLYING, ERECTING and TESTING of 28 SETS of CENTRIFUGAL PUMPS capable of pumping unscreened sewage, together with ELECTRIC MOTORS, AUTOMATIC STARTERS, FLOATS, VALVES, PIPES, &c., complete.

Conditions of contract, specification, plans and particulars of pumping stations can be obtained from Mr. C. Franklin Murphy, A.M.I.C.E., Chartered Civil Engineer, Lloyd's Bank Chambers, Morpeth, any time after this date on deposit of a cheque for £3, which will be returned on receipt of a bona fide Tender and the return of all documents provided for the purpose of tendering.

Sealed Tenders, on the form supplied, endorsed "Sewage Scheme, Tender for Pumps," must be received by the undersigned not later than Noon on Saturday, 26th February, 1927.

RAYMOND W. HASTINGS,
Clerk to the Council.

Council Offices, Spalding,
14th January, 1927. 4525

The Assam-Bengal Railway

COMPANY, Limited, is prepared to receive TENDERS for :—

10 SUPERHEATER BOILERS.

Specifications and Tender forms may be obtained at the offices of the Company, Bishopsgate House, 80, Bishopsgate, E.C. 2. A fee of £1 1s. is charged, which cannot under any circumstances be returned.

Drawings may be had, at the cost of the tenderer, by application to Messrs. Hodges Bennett and Co., Ltd., 78, Queen Victoria-street, E.C. 4.

Tenders must be delivered at the Company's offices not later than Noon on Thursday, the 17th February, 1927.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
THOS. C. BRETT,
Secretary.

26th January, 1927. 4623

The Madras and Southern Mahratta Railway Company,

Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—

DUPLICATE PARTS FOR LOCOMOTIVES (Axleboxes, Buffers, Cylinders, &c.).

Tenders are due in on Tuesday, 15th February, 1927, by 2 p.m. Tender forms obtainable at above address ; fee One Guinea, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender. 4627

The County of London Electric Supply Co., Ltd.

BARKING POWER STATION EXTENSION, 1926.

The County of London Electric Supply Company, Ltd., are open to receive TENDERS for the SUPPLY of CONDENSER TUBES for their extensions at Barking Power Station. Specifications may be obtained by manufacturers from the office of the Company on application to the undersigned, on or after January 31st, 1927.

Sealed Tenders, marked "Tenders for Condenser Tubes for Barking Extensions," are to be addressed to the Joint Manager and Secretary and lodged at the registered office of the Company by Noon on February 15th.

The Company do not bind themselves to accept the lowest or any Tender.

F. C. McQUOWN,
Joint Manager and Secretary,
The County of London Electric Supply Company, Ltd.,
Moorgate-court, Moorgate-place,
London, E.C. 2. 4602

City of Cardiff.

MECHANICAL ENGINEERING ASSISTANT.

APPLICATIONS are INVITED for the POST of MECHANICAL ENGINEERING ASSISTANT in the City Engineer's Department.

Candidates should be between 30 and 40 years of age and should have had at least twelve years' experience in a Mechanical Engineer's Drawing-office (exclusive of apprenticeship).

Applications will be considered only from those who have had a full practical training and a first-class experience in the design and construction of pumping engines, condensing plants, boilers, mechanical vehicles, &c. Experience of roof and girder work and reinforced concrete construction will be an advantage.

Salary £325 per annum, rising by annual increments to £350 per annum (subject to a deduction of 5 per cent. towards the Corporation Superannuation Fund).

List of duties and forms of application can be obtained from Mr. Geo. H. Whitaker, M. Inst. C.E., City Engineer, City Hall, Cardiff.

Applications, on the prescribed forms, to be sent to the City Engineer, not later than Saturday, February 12th, 1927, endorsed "Mechanical Assistant."

CECIL G. BROWN,
Town Clerk.

City Hall, Cardiff,
January 25th, 1927. 4614

PUBLIC NOTICES

DRAUGHTSMAN.

Structural Draughtsman Required

for Argentine Railway :—

(A) 2 CIVIL ENGINEERS, with good practical and theoretical experience in designing large railway schemes, such as terminal stations, yards, &c. Should also have some construction experience. Salary £650/700.

(B) 1 ENGINEER, with good practical knowledge of bridge erection and building work. Salary £650/700.

(C) 2 CIVIL ENGINEERS, experienced in maintenance of railway track and structures. Salary £500/550.

(D) 4 JUNIOR CIVIL ENGINEERS, with some railway experience, for assistance of constructing works. Salary £400/450.

(E) 2 PROBATIONARY CIVIL ENGINEERS, with first-class engineering degree. Salary £350/400.

Write, stating appointment applied for and giving particulars of education, training, experience, age, &c., with copies (only) of testimonials, to Box S. R., c/o Davies and Co., 95, Bishopsgate, E.C. 2. 4622

The Municipality of Malacca,

STRAITS SETTLEMENTS.
MUNICIPAL ENGINEER.
ADVERTISEMENT.

The Municipal Commissioners of the Town and Fort of Malacca REQUIRE a MUNICIPAL ENGINEER, age 28 to 35, preferably unmarried, on a four years' agreement, with possible extension.

Candidates must have received a good general and technical education and must be corporate members of the Institution of Civil Engineers.

The duties of the appointment comprise those usually carried out by a Borough Surveyor, including the construction and administrative work connected with Roads, Buildings, Bridges, Surface Drainage, Sewerage, Water Supply, and Conservancy. Training and experience in a Borough Surveyor's office are therefore essential. Preference will be given to candidates having special experience in Drainage and Sewerage Schemes, and accustomed to the control and direction of staff and workmen, and to the carrying out of works departmentally.

Salary 7200 dollars for the first year, 7500 dollars for the second year, 7800 dollars for the third year, and 8100 dollars for the fourth year of the agreement. The value of the dollar is 2s. 4d. sterling, and the pay of the appointment for the first year is therefore £840. Free unfurnished quarters will be provided. An allowance for the maintenance of a motor car or motor cycle for use on duty will be granted. Free passage will be provided, with half-pay during the voyage out. The selected candidate must pass an approved medical examination.

Applications, stating age and place of birth, and whether married or single, and giving details of education, training, and experience, referring to the above requirements in detail, and stating when free, accompanied by copies (not originals) of testimonials, and also personal references, must be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 64, Victoria-street, London, S.W. 1, Agents to the Commissioner, not later than Wednesday, 9th February, 1927. Further particulars, if desired, can be obtained from the Agents. 4617

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, Capable PRACTICAL MAN with Experience in the Erection of Furnaces applied to steam-raising plant. Candidates must be able to undertake the erection, starting to work, and hand firing of such furnaces and also able to take the necessary flue gas tests, and act generally as guarantee man. Age 24-26.—Address, stating age, experience, and salary required, together with copies of two recent testimonials, 4629, The Engineer Office. 4629 A

WANTED, STRUCTURAL STEEL WORK DESIGNER. Must have had London experience.—Address, stating age and salary required, P2691, The Engineer Office. P2691 A

APPLICATIONS are INVITED for the POSITION of a WORKS MANAGER, with thorough knowledge of the manufacture of Lancashire and other type Boilers, Boiler-house Structures and Equipment, and the establishment of piecework rates.

It is also desired that the applicant should have had experience in the design of Tools and the production of all types of Hydraulic Press Work.

Address, giving full particulars of experience, age, and salary required, 4635, The Engineer Office. 4635 A

APPLICATIONS are INVITED for a VACANCY in the Sales Department of an Engineering Concern in India. Only individuals of robust physique and good personality, who have been educated at a good-class school, have served apprenticeship and had sound technical education, need apply. Age not over 25, unmarried.—Write, Box 713, Leathwait and Simmons, 34, Throgmorton-street, London, E.C. 2. P2692 A

ASSISTANT PLANT ENGINEER.—Young Capable MAN WANTED, with up-to-date experience in Modern Production Methods and in Maintenance of Plant.—Apply by letter, giving full details of training and experience, age, &c., to C. A. VANDERVELL and CO., Ltd., Engineers, Acton, London, W. 3. 4599 A

ENGINEER, Mechanical, in Plant Department for specifications and estimates ; technical training and experience of Steam Boilers, Gas Producers, and Electrical Equipment essential. Knowledge of Building Construction and Pipe Work desirable.—Apply by letter only, stating age, experience, qualifications, and salary required, to EMPLOYMENT DEPARTMENT, Hans Renold, Ltd., Burnage Works, Didsbury, Manchester. 4596 A

MANAGER REQUIRED for Motor Business in West Africa. Must be thoroughly experienced salesman and mechanic, with previous Coast experience.—Address, stating age, experience, and salary desired, 4590, The Engineer Office. 4590 A

METALLURGIST, Technical Training and Practical experience with Ferrous Metals and their Heat Treatment essential. Knowledge of testing oils, fuels, &c., desirable.—Apply by letter only, stating age, experience, qualifications and salary required, to EMPLOYMENT DEPARTMENT, Hans Renold, Ltd., Burnage Works, Didsbury, Manchester. 4584 A

RATE FIXER and TIME STUDY MAN WANTED by Large Industrial Concern in Manchester area.—Address, stating age, salary expected, and full particulars of experience and training, 4554, The Engineer Office. 4554 A

REQUIRED for Phosphate Works, Central Pacific, an ASSISTANT MECHANICAL and ELECTRICAL ENGINEER, with sound knowledge A.C. Equipment and Current Distribution, Diesel Engines, General Machine Shop Practice and Draughtsmanship. Age about 30, single. Four years' agreement, first two £350 p.a., remainder £375. Second-class passage paid out and home. Free board, quarters and medical attention.—Address, with full particulars and copies testimonials, P2658, The Engineer Office. P2658 A

SITUATIONS OPEN (continued)

REQUIRED, MARINE ENGINEER for Service on River Boats in the East, age under 35.—Write, with full particulars, to "Q. A.," c/o Street's, 6, Gracechurch-street, E.C. 3. 4603 A

SALESMAN REQUIRED, Preferably Residing in North of England, for De Laval Centrifugal Oil Purifiers, &c. Expert salesmanship combined with engineering and technical knowledge essential. Salary and commission. Good prospects.—ALFA-LAVAL CO., Ltd., 24, Grosvenor-road, S.W. 1. P2669 A

SOLICITOR REQUIRED, Qualified Engineer, as expert witness in legal matters. State qualifications, experience, &c.—Address, P2702, The Engineer Office. P2702 A

WELL-KNOWN FIRM Specialising in Power Transmissions and Machine-cut Gearing, REQUIRE the full-time SERVICES of First-class ENGINEER as REPRESENTATIVE for South Wales. Must be thoroughly familiar with Colliery and Steel Works Equipment. Give full particulars of qualifications, age, and salary required.—Address, 4597, The Engineer Office. 4597 A

WELL-ESTABLISHED GENERAL ENGINEERS in Midlands with large foundries and good machine shops would CONSIDER ENGAGEMENT of young ENGINEER EXPERT in suitable speciality with a view to development. Capital not necessary. Correspondence confidential.—Address, 4613, The Engineer Office. 4613 A

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

High-speed Vessels.

IN giving the James Watt anniversary lecture at Greenock on Friday of last week, Mr. Harold Yarrow chose as his subject the development of the high-speed vessel. He suggested that the importance of scientific and industrial research as affecting the prosperity of the country was not sufficiently appreciated by the Government, and showed how the design of the hull and machinery of fast vessels was influenced by experimental work. Reference was made to the conflicting requirements of high-speed ships, namely, reliability, strength, fuel capacity, and comfort, all of which had to be considered and balanced in getting out a given design. As regarded the shape of the hull, Mr. Yarrow mentioned that experiments made at the Experimental Tank of the National Physical Laboratory, Teddington, had enabled a reduction of 5 per cent. in fuel consumption to be effected over a large range of ships by improving the form of the hull. He also instanced the value of aeronautical research as having a direct bearing on the air resistance offered by high-speed ships. Not less important, he thought, had been the research work carried on by metallurgists, which had resulted in the introduction of high-tensile steels and strong non-ferrous alloys for propeller work. Dealing with improvements in propelling machinery, Mr. Yarrow recalled the important work which was done by the French firm of Augustin Normand, of Havre, in the development of the light-weight reciprocating steam engine, which was followed by the striking introduction of the marine steam turbine. Comparing the weights of steam turbine machinery for destroyer work with those of a marine oil engine, Mr. Yarrow stated that, whereas the weight of the complete turbine propelling machinery for a torpedo-boat destroyer, including boilers and auxiliaries, was only 25 lb. per horse-power, that of the oil engine was very much higher, which fact at present limited its use when large horse-powers were required. The lecture concluded with a brief description of the Clyde geared turbine passenger steamer King George V. and its recent successful performance.

The North-East Coast Exhibition.

AT a meeting held at Newcastle-upon-Tyne last week it was definitely decided to proceed with a proposal to hold a North-East Coast Exhibition at Newcastle in May, 1928. The proposal of Mr. C. P. Hainsworth, the organiser and manager, to raise £150,000 as a guarantee fund is being taken up by the industrial and shipbuilding concerns on the Tyne, and it is hoped that the desired amount will be subscribed before the end of next month. The object of the exhibition, we understand, will be to display the products of the North-East Coast districts and to endeavour to attract new industries to that part of the country. The British Dominions will also exhibit. Speaking at the luncheon at which the proposal was adopted, the Duke of Northumberland referred to the widespread opinion that after the recent severe industrial depression some energetic effort was necessary to develop trade and attract new industries. He reminded those present that it was necessary to show the world that the qualities of initiative, industry and resource which in the past had gone to build up industry were still with us. An endeavour should be made, he thought, to escape from past depression by determining to enter upon a new period of prosperity. A central office for the exhibition has been established at Pearl Buildings, Northumberland-street, Newcastle.

Soviet Naval Forces.

THE League of Nations secretariat has received from Moscow a communication purporting to give the strength of the Soviet naval forces in the Black Sea. According to this return, the present Black Sea fleet comprises one cruiser, four first-class torpedo boats, fifty-four submarines, three gunboats, two sloops, nine minesweepers, eleven small craft, and one vessel of 3000 tons for special service. These figures are demonstrably inaccurate. It is known positively that the Russian forces in the Black Sea are of almost negligible strength. The only large vessel is the cruiser Tchervonaya Ukraina—ex Admiral Nakhimoff—which was launched at Nikolaieff in 1915, and eventually towed to Odessa for completion. Whether she is armed and seaworthy is doubtful. A much older cruiser, the Komintern—ex Pamiat Merkuria—has been laid up for some years past. In addition, there are six destroyers, four submarines and five small gunboats or sloops. There is reason to believe that not all of these vessels are in commission. A number of ships that formerly belonged to the Black Sea fleet are still in French custody at Bizerta, the negotiations for their return to the Soviet Union being apparently in abeyance. They include a Dreadnought battleship, a cruiser, six destroyers and four submarines. With regard to the Moscow claim that fifty-four submarines are in the Black Sea alone, reference to the British official "Return of Fleets," published last January, shows that the total number of Russian submarines at that date was twenty-three, most of which were in the Baltic. Three new submarines were listed as being built; and are believed to be the only naval craft at present under construction anywhere in Russia.

Railway Rates.

THE new railway rates which are to come into operation on February 1st, and which will raise the charges made by the companies from 50 per cent. above the pre-war rates to 60 per cent., continue to be the subject of much adverse criticism throughout the country. So far as the engineering industry is concerned, it is held to be unfair, according to a resolution passed by the British Engineers' Association, that railway rates should be increased without at least three months' notice being given. The industry, the Association points out, is at present working on very small margins, in order to recover trade, and the interval mentioned is necessary to enable manufacturers to avoid or minimise the effect of this new encroachment on these margins with respect to existing contracts. Manufacturers and traders, the Association states, receive daily experience which makes it abundantly clear that considerable railway economies could be effected, and it is strongly felt that the possibilities of effecting such economies should be fully investigated before any additional handicap such as is involved in the proposed increase of rates is placed on industry and trade. We pointed out in last week's issue that as the new rates are to be made under the Railway and Canal Traffic Act of 1889, they are subject to objection, and if they are objected to they have to be justified.

Geared Diesel Locomotive Trials.

FINAL trials were recently carried out near Düsseldorf with the Hohenzollern-Lomonossoff geared Diesel locomotive before its dispatch to Russia. The locomotive, which was designed and constructed at the Hohenzollern Locomotive Works, Düsseldorf, and built and tested under the supervision of Russian engineers, was fully described and illustrated in our issue of July 9th last. It will be remembered that it is equipped with a six-cylinder standard M.A.N. submarine type engine, designed for a maximum output of 1200 B.H.P. at a speed of 450 r.p.m. The power is transmitted through magnetic clutches, supplied by the Magnet-Werk, of Eisenach, and Krupp reduction gearing to ten coupled driving wheels, there being a bogie in front and a trailing axle behind. The recent trials were made between Opladen and Vohwinkel, with trains of about 400 and 800 tons. Previous trials had shown the locomotive to be capable of drawing a load of 1330 tons up a reasonable gradient. The designed maximum speed is about 30 miles per hour and the cost of the locomotive—the first of its type—has been stated to be about 450,000 marks, or, say, £22,300. A similar locomotive of the 2–10–2 type, with a new type of high-speed Diesel engine and mechanical gearing, has been ordered by the German State Railways from the Hohenzollern Company, which is to be built for a higher train speed.

America's Merchant Fleet.

THE announcement that the United States Shipping Board has rejected all tenders for the taking over by private owners of the Government-owned fleet is not contrary to anticipation. The bids were rejected, we understand, on the ground of their inadequacy, which means that the Government will still be required to run the United States and American Merchant Lines. According to official figures published within the last few days, of the £120,000,000 spent on the transport of America's foreign trade, only about one-third was received by vessels under the American flag. In this connection it is of interest to note that out of the 4009 ships entering New York from foreign ports during the year ending December 31st, 1926, 1894 were British vessels, representing a total of 9,618,900 net tons, which exceeds the American figure of 1820 ships, with a total net tonnage of 6,587,945. The decision of the Shipping Board will, it is believed, clear the way for a determined effort to enlist the aid of national resources to create a powerful mercantile fleet which would be capable of meeting the whole of the requirements of American commerce and serve as an auxiliary for naval and military services.

London Telephones.

A STATEMENT of telephone progress in the London area during the year 1926 has just been issued by the Post Office. During the year there was no alteration in the boundaries of the London telephone area, which covers 750 square miles, and extends from Reigate to Waltham Cross and from Tilbury to Hayes, Middlesex. The impending conversion of part of the London system to automatic working has made it desirable to regard the area as divided into two portions, the first, generally known as the automatic area, comprising the exchanges situated within a 10-mile radius of Oxford Circus, and the second, the London area, outside this automatic region, in which exchanges will continue to work on the manual system. With the opening of seven new exchanges and the closing of the Bank and Latchmere exchanges, the total number of exchanges in the London area is now 112, including the Trunk and Toll exchanges, as compared with 107 last year. The Toll exchange deals with calls to the principal provincial towns within a radius of approximately 30 miles of London, and the Trunk exchange with calls to all districts in England, other than those served by the Toll exchange, also Scotland, Ireland and those countries in Europe which can be linked up with the British telephone system. The number of exchange lines connected to the London exchanges at the end of 1925 was 269,801, whilst at the end of 1926 the number was 298,766, the net increase for the year being 28,965, or about 10·7 per cent. The demand for private wires connecting subscriber's offices and not connected to the public exchange system continues to increase, the total number now being 15,400. The 500,000th London telephone was installed on July 16th, 1926, and the occasion was marked by a brief ceremony in the Press Gallery in the House of Commons, when the telephone was formally handed over by the Controller of the London telephone service to Mr. Harvey, Chairman of the Press Gallery. The telephone is fitted with a tablet bearing a small inscription. Those who are interested in telephone progress will find much information in this new publication, which is issued by the Controller of the London telephone service and the Superintending Engineer of the London engineering district.

Oil Cracking and Extraction Processes.

THE report from the American Bureau of Mines regarding a new cracking and extraction process invented by two of its engineers, Messrs. C. P. Bowie and M. J. Gavin, and named after them the Bowie-Gavin process, revives interest in the problem of making the fullest use of a crude oil and recovering increased amounts of valuable products from heavy oils, oil shales, oil-soaked sands and tars. The application of the new process will, it is stated, prolong the life of the American oilfields and open up new sources of supply from the oil shales in the Western States. In Great Britain the problem has been attacked by the Cross process, which has been adopted by three of the principal British oil interests. We are able to state that a fourth Cross cracking plant has recently been ordered from a British port, which will have double the capacity of the existing installations and will be completed towards the end of the year. It will embody certain new developments which have been shown considerably to widen the scope of application of the process.

The Electricity Board.

THE recent announcement by the Ministry of Transport that Sir Andrew Rae Duncan is to be the first chairman of the Central Electricity Board has created great satisfaction in the shipping world. Originally, Sir Andrew was a teacher, but his bent was towards the law, and he graduated LL.B. and M.A. at Glasgow. He was trained in the offices of a Glasgow firm of solicitors, where, in addition to gaining experience in ordinary legal work, he obtained a very comprehensive knowledge of industrial questions, especially of those which are always coming before the shipbuilding and engineering employers' organisations, and when the Shipbuilding Employers' Federation found it necessary to establish headquarters in London, Mr. Duncan was appointed secretary. He is an acknowledged authority on industrial subjects, and he served with distinction as Coal Controller for some time after the close of the war. In 1921 he was knighted in recognition of his wartime services on various Government Committees and his work as Coal Controller. In 1925 he went to Nova Scotia on the invitation of the Government of that province to act as Chairman of a Commission of Inquiry into the coal situation, a position which he filled with conspicuous success. He has been a permanent Vice-president of the Shipbuilding Employers' Federation for a good many years, and is one of the British technical assessors on the Permanent Court of the League of Nations.

The London Terminal Air Port.

THE returns for last year for the London terminal air port at Croydon show an advance over the traffic of previous years. Altogether about 26,500 passengers were carried, of which 16,600 travelled in the Imperial Airway's machines, the remainder travelling in machines belonging to French, Dutch, and Belgian lines, with, later in the year, an occasional German machine. The traffic on the London-Paris route was the busiest, and during the month of August some 6000 passengers used the port, the largest number carried in any one week of that month being 1313, as against the 1125 of the previous highest record. The actual number of arrivals and departures in the year was 5446. The year was notable for the improved lighting facilities provided at the port, which enable machines to land safely in misty weather. Good progress is now being made with the erection of the new buildings at the port, which, when completed, will provide still better air port facilities.

Coilers for Cold Strip Rolling Mills.

No. I.

By C. E. DAVIES, A.M.I. Mech. E., M. Inst. Met.

EVERY rolling mill, producing cold-rolled strip either in steel or in non-ferrous metals, requires some form of coiler or winding device for coiling the metal as it issues from the rolls, but this very essential accessory rarely receives the attention and study which it deserves. The neglect is mainly due to the fact that the real function of this machine in a cold rolling equipment is in many cases very incompletely understood.

The primary purpose of the coiler is, of course, merely to dispose conveniently of the long strips of metal, which in the earlier days of the industry were probably coiled up by hand by the roller's assistant. That method was possible, first, because the length of strip in one piece was comparatively short, and, secondly, because the rolling speed was low. It is surprising to find that even at the present day hand coiling is still employed in many smaller mills, and it is necessary to point out that this practice is not economical, requiring, as it does, the constant labour of a second man on the mill.

Hand coiling is only advantageous when dealing with very short strips, in comparatively heavy gauges, as the time of rolling of each piece is very short, and even with a power coiler labour is continually required to start the metal on the coiler drum and to remove the finished coils. It is, however, not usually economical or necessary to roll short lengths,

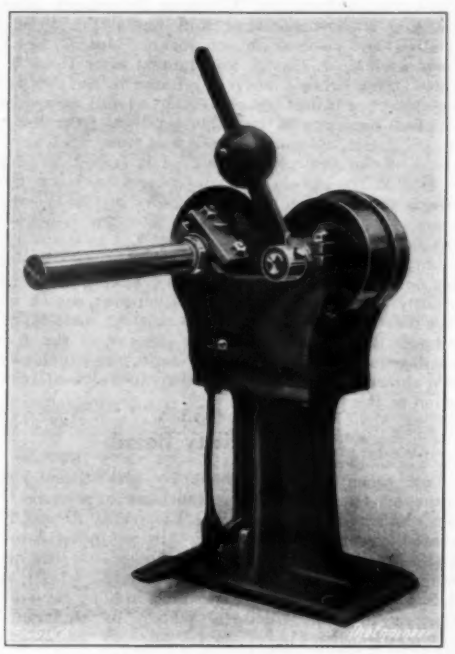


FIG. 1—SIMPLE FORM OF WINDER—G. JONES

and some form of mechanical coiler is generally required.

The substitution for the hands of the workman of a simple coiling spindle, round which the metal strip is wound, but still operated by a hand crank, is the next step and is also still employed to a small extent. This hand-operated winder enables the operator to coil the metal more tightly and to produce more even coils of definite diameter; but otherwise has all the disadvantages possessed by the primitive method of rolling up the coils by hand.

In modern cold rolling practice brass and similar non-ferrous metal strip is rolled in continuous lengths forming coils 40 lb., 80 lb., or 100 lb. in weight, and, in wide strip, even heavier, whilst steel is rolled in 200 lb. coils when only 2in. to 3in. wide. It is clear, then, that the expeditious and convenient coiling of such heavy pieces requires the provision of properly designed machinery.

Even a 40 lb. coil of brass strip only 4in. wide and ·005in. thick contains a very great length of strip, and in the process of producing this gauge by cold rolling from the ingot the same metal has to be coiled and re-coiled very many times; for it is not only in the finishing pass when the strip is wound into a convenient form for transport to the customer that coiling is necessary, but after most of the many intermediate passes. Rolling from an ingot 1¼in. thick to strip ·010in. thick usually requires about twenty-four passes, and after at least twelve of them coiling is necessary.

Besides the mere convenience of winding the metal into the form of a coil, there is also the necessity of economising space in the annealing furnace. With small tightly wound coils a greater weight of metal can be charged into a furnace of given capacity, and the best practice is to coil as soon as the metal is thin enough to permit it. Special types of coilers are now available for winding thick and wide metal, and strip nearly ¼in. thick is coiled with the advantage that the coils can be closely packed into a furnace of moderate size instead of being put in as straight lengths, requiring a very long furnace. Besides this economy in furnace space with coiled metal, there is also the even greater advantage in obtaining a more uniform temperature throughout the length of each piece; with long straight lengths it is almost impossible to

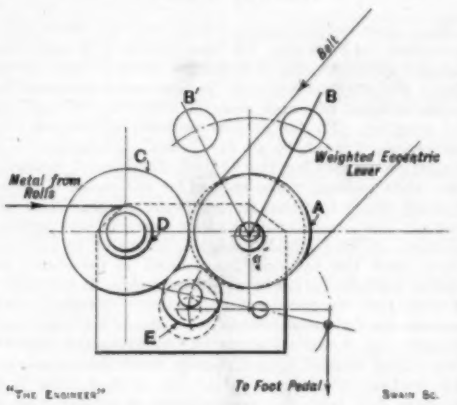


FIG. 2—DIAGRAM OF MECHANISM OF SIMPLE WINDER

ensure exact uniformity of annealing throughout the whole length of each strip.

From the foregoing remarks it will be seen that the coiler is second only in importance to the rolling mill itself, and practically every modern strip mill is equipped with some form of power-operated coiler. An example of a simple form of winder, made by George Jones, Ltd., of Birmingham, is shown by Fig. 1. This design is still very popular in many non-ferrous metal strip mills and has the advantage of being inexpensive and easy to operate. The metal is wound on an extension of the coiler spindle, which is provided with a slot running its whole length, into which the leading end of the strip is inserted. The machine is belt driven from an overhead countershaft and the drive is transmitted from the pulley shaft to the coiler spindle by friction wheels. This friction device provides both means of adjusting the coiling tension and of compensating for the increasing speed of coiling as the diameter of the coil gets larger. In order to remove the finished coil without difficulty a reversing device is provided so that the coil may be partially unwound and thereby loosened on the spindle. A diagram illustrating the mechanism of this simple coiling machine is shown in Fig. 2. The belt pulley A, which is in one piece with the driving friction wheel, runs free on a spindle which is carried in excentric bearings. By means of the weighted lever B this friction wheel is forced into contact with the driven friction wheel C keyed to the coiler spindle D, with more or less force depending on the tension required. A third idle friction wheel E may be interposed between the two main friction wheels A and C by means of the foot pedal, making contact with both wheels and reversing the direction of rotation of the coiling spindle. The coiling spindle is of comparatively small diameter, usually 2in. to 3in., but is sometimes fitted with a loose drum of larger diameter; in this case the drum also has a slot for the end of the strip and is driven by a key which enters the slot in the coiler spindle.

This coiler, although, as mentioned above, still popular in many brass strip mills, is only especially suitable for comparatively soft metals and alloys of moderate width and lighter gauges, and its limitations bring forward another important function of the strip mill coiler generally.

Besides winding the metal into coils of convenient dimensions for handling and charging into the annealing furnace, an efficient coiler should remove any "buckles" or curvature across the width of the metal as it leaves the mill rolls. As mentioned in a recent article by the present writer on the subject of "Spread of Metals in Cold Rolling"—THE ENGINEER, June 11th and 18th—this buck ing is due to the tendency for cold-rolled metals to "spread" or increase in width to a greater extent at the edges of the strip than at the centre with resulting unequal elongation across the width. Hence the strip leaves the rolls in the form illustrated by Fig. 3, the cross section being, as shown, exaggerated, at A. As the edges are actually shorter than the centre line the whole strip becomes buckled and curved lengthways as at B. A properly finished cold-rolled strip should be flat and flexible, and some means of removing any buckle caused by the rolling operation must be provided. Obviously the only way to do this is to stretch the edges of the strip to match the length of the centre portion and, providing the buckle is not excessive, this operation is conveniently performed by the coiling apparatus. It will be seen that the winding of a metal strip tightly on a drum or spindle gives the desired flattening effect by a combination of two actions. First, in order to coil the metal evenly and tightly a considerable tension must be applied by the winder, which tension on a buckled strip is first concentrated on the edges, resulting in local stresses exceeding the elastic limit of the material and causing elongation of the edges until the lengths are equalised sufficiently to distribute the applied tension uniformly over the cross sections of the strip. Secondly, the action of bending the metal round a circular centre does in itself causes a flattening of any buckle, and the smaller the radius of the coil the greater the flattening effect. The older type of coiler, as illustrated by Fig. 1, had necessarily a drum or winding spindle of comparatively small diameter, primarily in order to give a sufficiently great tangential pull, with the limited driving force available, and also to provide the effect of bending the metal to a curvature of small radius.

Theoretically, of course, providing that the strip is tightly coiled on any size of drum, the buckle must be removed and the length of the strip equalised across its width; but it must be remembered that, with reasonably well rolled metal, the amount of buckle and the variation in length is naturally very small, and to remove this inequality the strip must be wound so tightly that it makes uniform contact with the

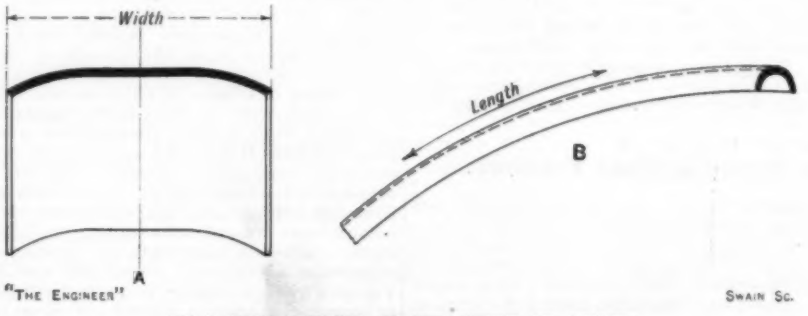


FIG. 3—STRIP BUCKLED AS THE RESULT OF ROLLING

drum surface, or that of the preceding layers, over the whole of its width, whereas the mere coiling of the metal to a cylinder of small radius, even without any centre or drum, has the effect of stretching the edges and removing any buckle.

Generally it may be stated that light coiling machines, winding the metal on a small diameter drum, are effective only for light gauges and moderately soft metals, whilst for heavier gauges and harder metals, a larger drum must be employed and consequently a very much greater torque must be applied to the coiler spindle.

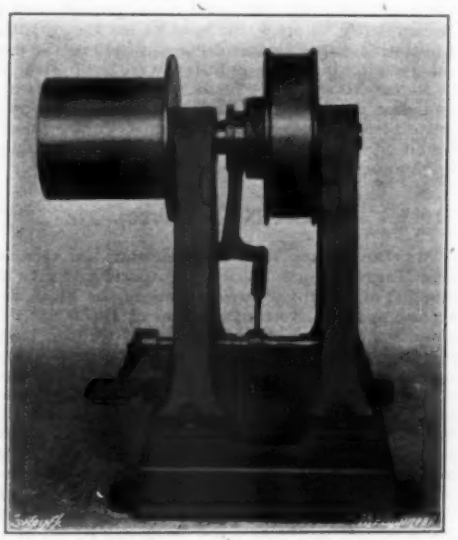


FIG. 4—WINDER WITH PEDAL-OPERATED CLUTCH

In most British mills producing strip brass, it is preferred to coil the metal on a spindle or drum of comparatively small diameter, for the reason that the annealing furnaces installed are adapted for dealing with coils of small diameter; continental practice,

on the other hand, generally favours larger coiling drums, and the annealing equipment is designed to suit the larger size coils.

Another simple form of coiler is shown by Fig. 4.

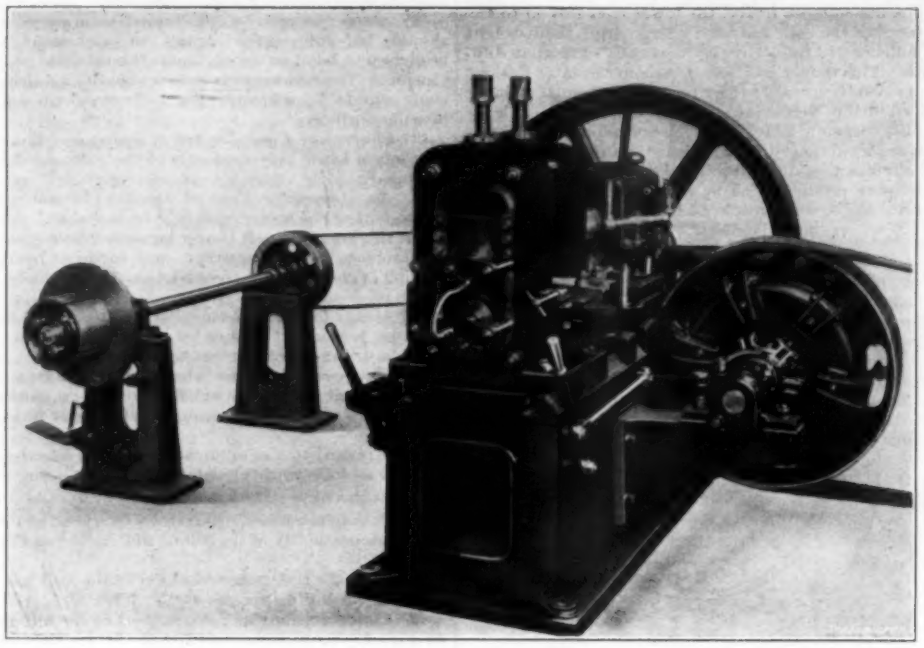


FIG. 5—SIMPLE COILER BELT-DRIVEN FROM STRIP MILL

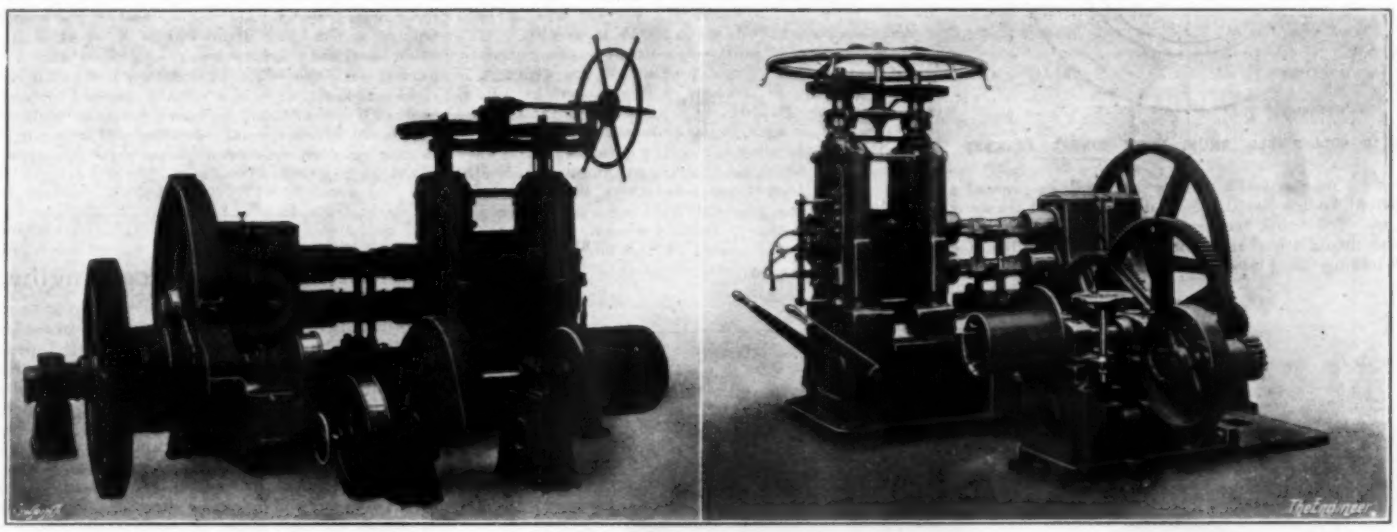
This machine also is belt driven from an independent countershaft, but has a drum of larger diameter and a pedal-operated clutch for stopping and starting it independently of the mill. The drum spindle in this design is carried in bearings mounted on a swivel plate, pivoted on the base plate proper, so that the drum may be accurately aligned with the rolls.

Both machines described in the foregoing are arranged for belt drive from a countershaft, which is usually driven independently off the drive to the rolls themselves; but in modern installations it is more usual practice to drive each coiler from its own mill, thus forming a complete unit of mill and coiler. Fig. 5 shows a coiler of this type in conjunction with a strip mill, and this arrangement is very generally adopted for the smaller strip mills with rolls from 6in. to 10in. diameter. The coiler consists simply of the drum and its shaft, carried in self-oiling bearings mounted on suitable supports, the opposite end of the drum shaft being fitted with a flanged pulley to take a belt drive from a similar pulley fitted to the outer end of the lower roll pinion.

In the last two examples of coiling equipment, it will be noted that a fairly large drum is employed, on which the metal is wound, instead of directly on to the spindle, as in the machine shown in Fig. 1. The tension applied to the strip is relied upon to remove any "buckle," as explained above; but as the belt drives direct on to a pulley, which is generally of approximately the same diameter as the drum itself, the tangential pull exerted, at the drum periphery, on the metal is limited to the resistance to slip of the belt, which may be from 2in. to 4in. wide, according to the size of the mill. Obviously therefore such simple ungeared coilers are only effective for dealing with comparatively narrow strip in light gauges, or for very soft metal and alloys in greater thicknesses or widths.

Rolling mill engineers are beginning to realise the importance of the coiler and its influence on the quality of the production, and more and more powerful coiling devices are being installed, especially when rolling wide and thick strip. To produce flat strip free from buckles in brass, aluminium, &c., 12in. to 18in. wide in moderately heavy gauges, calls for a very powerful coiling tension, which can only be obtained by providing a reduction gear between driving pulley and drum shaft, the pulley in such a case being driven at a speed considerably greater than that of the rolls. Fig. 6 shows a good example of a powerful geared coiler, installed in a modern strip rolling mill, by Robertson and Co., Bedford. It is of very heavy construction throughout. The drum, 20in. diameter, and designed to coil metal up to 18in. wide, is of the collapsible type to facilitate removal of the finished coils, and is mounted on a steel spindle of large diameter running in self-oiling bearings. The machine-cut reduction gear between the pulley shaft and the drum spindle has a large ratio, and the belt pulley is large in diameter and of ample width. This pulley also contains a friction device whereby the tension applied to the metal may be regulated to suit the width and thickness of the strip coiled. With the increasing power of the coiler some device of this nature becomes essential. The ungeared coilers depend entirely on the belt slip to compensate for the increasing diameter of the coil as the metal is wound, and as this slip varies with the condition and tightness of the driving belt the tension obtained is variable and uncertain. All coiler drums are designed to revolve at a speed which when unloaded gives a velocity at the drum periphery from 5 per cent. to 10 per cent. greater than the rolling speed. The belt must, therefore, have an initial slip of that amount, which increases as the coil grows in size. This slip alone causes considerable wear and tear on the belts and consequent expense in maintenance; and it is on account of this excessive belt slip that most coiler driving pulleys are flanged to prevent the belt from running off them. With the modern heavy geared coiler, while there is still the necessity for the excess speed of the coiler drum, the belt power provided is ample and only normal working belt slip is allowed. Any excessive slip to compensate for speed difference is taken up in a friction clutch or similar device, which is easily adjusted for wear. In this way a regular and properly adjusted tension on the strip can be obtained under all working conditions.

A similar result is obtained in the coiler shown in conjunction with a strip mill, also made by W. H. A. Robertson and Co., Ltd., of Bedford—in Fig. 7. The coiler, which is geared, forms an integral part of the mill frame work, the mill and coiler being, in fact, all one machine. A belt drive is employed between the mill gear shaft and the coiler pinion shaft, but in order to adjust the coiling tension, a jockey pulley, movable vertically on the belt, by means of a hand wheel and screw, is provided. This arrangement enables a convenient short drive to be used, by increasing the angle on the pulley embraced by the belt, and also permits the adjustment of the belt slip to suit requirements.



FIGS. 6 AND 7—EXAMPLES OF GEARED COILERS

With very wide strip, 2ft. and wider, the drum becomes too long to be overhung, as the very considerable pull exerted would bend the drum spindle, and an outer bearing is fitted to the drum shaft; this

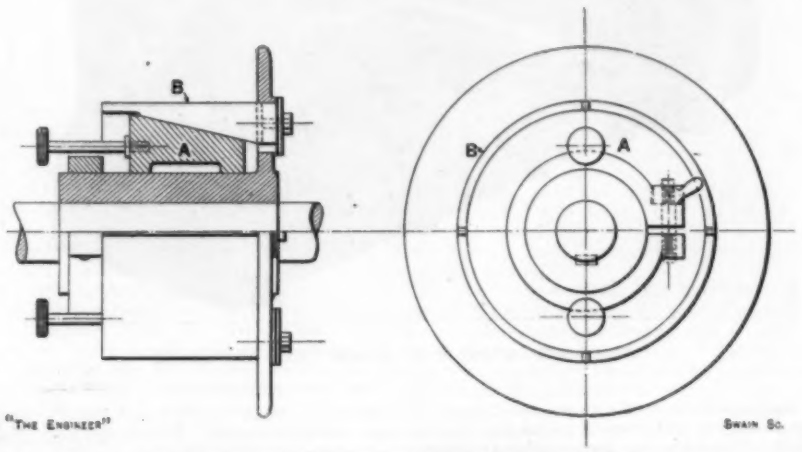


FIG. 8—COLLAPSIBLE DRUM FOR RELEASING COILED STRIP

bearing is mounted on a hinged bracket which, by removing a locking pin, may be swung clear, thus allowing the free removal of the finished coils.

The type of drum fitted to modern coilers calls for special mention. To remove tightly wound coils of

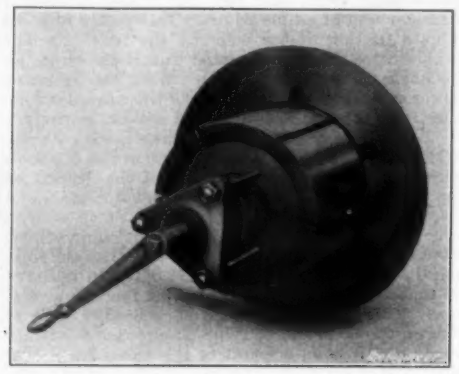


FIG. 9—SCREW DEVICE FOR WITHDRAWING CONE

considerable weight from a plain drum is a difficult matter; consequently, with the heavier coilers some form of collapsible drum is necessary. With the small drum and moderate coiling tension, especially with fairly springy material, reversal of the drum

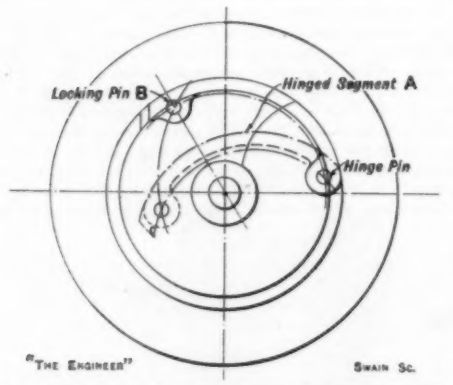


FIG. 10—COLLAPSIBLE DRUM WITH HINGED SEGMENT

either by mechanical means or by hand, is generally sufficient to release the coil, a few turns backward by use of a crank handle fitted near the periphery of the drum being quite effective; but with heavier coils having many layers, as required in modern rolling

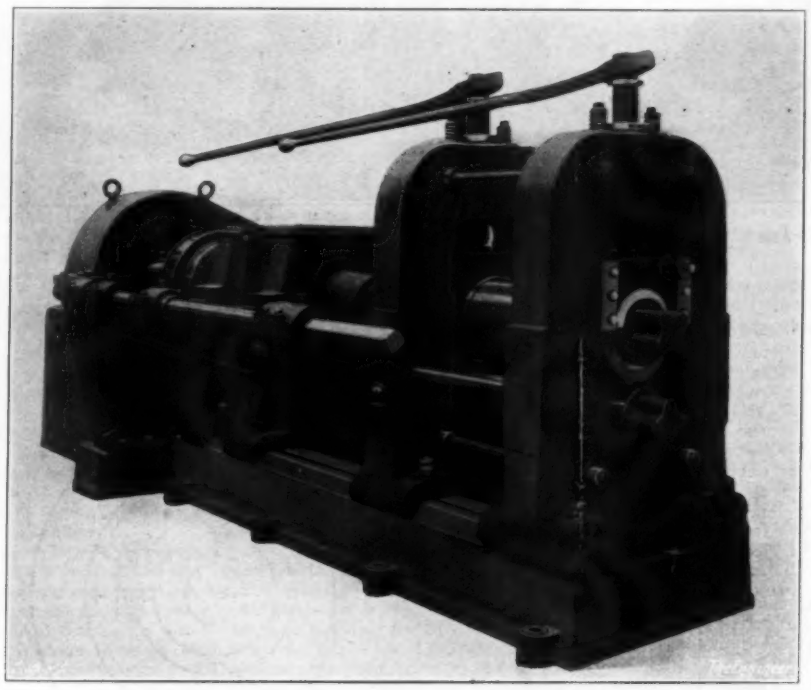


FIG. 11—HIGH-SPEED STRIP ROLLING MILL AND COILER

practice, tightly wound on the drum, some means of collapsing the drum and thereby releasing the coil is necessary. There are too many different designs of collapsible drums to describe all the variations in the space of this article, but a few typical examples will serve to illustrate the principles. Fig. 8 shows a very successful type. In it by partially withdrawing the internal cone A, the drum shell B, which is made in four or six segments, can collapse towards the centre. This design has the advantage of giving an ample and fairly uniform collapse, besides being very robust in construction and consequently suitable for heavy coiling tension. In older varieties of this design there is a disadvantage, that, whilst the upper segments collapse freely, the lower ones fall on to the interior of the coil, and with a large drum their weight is sufficient to render removal of coils somewhat difficult. This defect has been overcome in later designs by providing springs to give positive and equal collapse to all drum segments. Furthermore, with a large drum, carrying heavy coils, a considerable effort is sometimes required to withdraw the inner cone, and to obviate this difficulty the design shown in Fig. 9 has been produced. The credit for this design is mainly due to the Whitehead Iron and Steel Company, of Newport and Tredegar. It provides a screw,

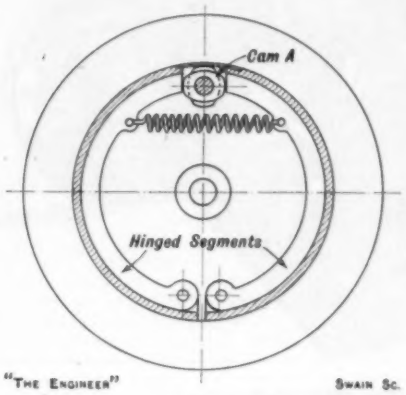


FIG. 12—COLLAPSIBLE DRUM WITH TWO HINGED SEGMENTS

operated by a removable crank handle, by means of which the internal cone is positively withdrawn. A few rapid turns of the crank are sufficient to give an ample collapse, and means are also provided to insure equal collapse of all drum segments. Many drums of this type are in successful service coiling cold rolled steel strip in coils up to 200 lb. in weight.

Another class of collapsible drum is illustrated by Fig. 10. In this case a portion of the drum A is arranged to hinge inwards, being locked by pin B when coiling. This device is simple but has the disadvantage of giving unequal collapse, and the effective reduction in diameter is small. A further type very common on the Continent is shown diagrammatically by Fig. 12. Here the two halves of the drum shell are hinged at one side and held together by tension springs at the other. During winding the drum is fully expanded by means of the cam A, which is rotated by a convenient removable crank handle, and which, when turned to the dotted position, allows the drum to collapse. This design has a disadvantage as compared with the segmental type previously described, in that the collapse is not uniform, and is almost entirely in the direction of the horizontal centre line, with scarcely any reduction in diameter at right angles to that line.

Generally, the essential features of an effective coiler of the regular type, such as those already described, are:—

(1) *Ample Driving Power.*—Geared coilers are preferable to the plain belted type. Belt pulleys should be liberally designed for wide belts and should have as large diameter as is convenient.

(2) *Ample Strength.*—Coiling spindles, in particular, should be sufficiently strong to withstand any tendency to bend or spring under the heaviest coiling tension. The bearings for coiling spindle and driving shaft should be correspondlingly heavy with ample bearing surface.

(3) *Convenient Provision for Stopping and Starting the Coiling Drum* independently of the rolls, should be provided.

(4) *An Adjustable Tension Device*, preferably independent of the belt slip, should be included.

(In this connection it is now becoming best practice to eliminate belts altogether, and to drive by spur gearing or chains relying on a friction device, solely, for speed adjustment.)

(5) *Means for Easy Removal of Tightly-wound Coils* must be provided. Either by use of an efficient collapsible drum or by a reversing mechanism.

If these conditions are observed, any extra first cost involved will be repaid by economical working, elimination of breakdowns, and the superior finish of the product.

With regard to the application of the coiler to the mill, the following alternatives have been considered:—

(1) Coiling machines, driven from overhead countershaft independently of the rolling mill itself—as Figs. 1 and 4.

(2) Separate coilers belted direct to the mill gearing—as Figs. 5 and 6.

(3) Coilers forming an integral part of the mill itself as Fig. 7. Arrangements (2) and (3) are preferable to (1), and are usually adopted in modern strip rolling installations.

There is still a further method of arranging the coiler in conjunction with the rolls—as shown by Fig. 11—which illustrates a high-speed strip rolling mill, in which the coiling spindle is mounted in bearings carried in the roll and pinion housings themselves. The spindle is belt or chain driven from the rolls, and is usually provided with some friction device and disengaging clutch; the coiling end of the spindle is square and a loose drum either of wood or iron is used, duplicate drums being employed and are removed with the coil. This design makes for a very rigid construction, and is usually worked in conjunction with some automatic coiler guide for high rolling speeds, to which special reference will be made later. Coiling gear on this principle is very generally employed in the United States.

Institution of Mechanical Engineers.

ON Friday evening of last week an important paper, entitled "The Use and Economy of High-pressure Steam Plants," was presented before the Institution of Mechanical Engineers by Professor A. L. Mellanby and Professor William Kerr. We begin a reprint in full of this paper elsewhere in this issue.

Mr. H. M. Martin was called upon by the President to open the discussion. There were two ways, Mr. Martin said, both perfectly legitimate, of dealing with problems of the kind discussed in the paper. In one an attempt might be made to determine what was technically possible and in the other what in the immediate present was economically practicable. Both points of view were of interest because the progressive development of manufacturing methods tended steadily to diminish the gap between the theoretical ideal and what was commercially attainable. In 1912 the best steam turbines had, he continued, an efficiency ratio of about 70 per cent. To-day figures of over 80 per cent. were recorded. Some small part of the gain registered had no doubt been due to an increase of knowledge, but the bulk of the advance was attributable to financial considerations. A generation ago a thermal efficiency of 16 per cent. reckoned on indicated horse-power was regarded as high. To-day the thermal efficiency of the large Parsons turbine supplied to Chicago was probably of the order of 30 per cent. It was of great interest to note that the authors as one result of their very elaborate and comprehensive analysis, concluded that a thermal efficiency of 42 per cent. was not beyond the bounds of what was technically possible. A paper of the type under discussion suffered from the drawback that only those who had been engaged in somewhat similar work could appreciate the immense amount of tiresome and tedious arithmetic required to attain results which ultimately were represented by a few simple curves. Such work was sufficiently onerous when only two variables were involved. The labour necessary in the authors' case must have been greatly increased by the very numerous variables of which account had to be taken. Engineering being more of an art than a science, it was possible that other workers might not in all cases make exactly the same assumptions as the authors had done. For example, the authors had assumed that clearances were unaffected by dia-

meter. He himself had been accustomed in corresponding circumstances to assume that the clearances varied as a fractional power of the diameter. Differences of individual opinion on such very minor matters of detail had, however, little effect upon the final results. During a recent visit to Sweden he had been informed at the de Laval works that that firm had had no trouble whatever with the turbines working at 1600 lb. steam which it had exhibited at Stockholm round about 1893. The boilers, however, behaved so badly that more moderate pressures were reverted to. The firm had recently supplied two turbines rated at 400 to 500 kilowatts to work with steam supplied at 1400 lb. pressure from Blomquist boilers. He was further informed that a Swedish maker was supplying two kinds of special steel, one of which was trustworthy at 600 deg. Cent. and the other of which was still strong at 800 deg. Cent. The authors, he noted, proposed progressive feed heating up to the boiler pressure. That procedure was theoretically possible, but in practice it could not, he thought, be carried out without the use of some form of heat pump. Saturated steam at 1000 lb. pressure had a temperature of about 447 deg. Fah. If superheated to a total temperature of 900 deg. Fah. and then expanded adiabatically down to 447 deg. Fah. its pressure would be only 173 lb. instead of 1000 lb., with the consequence that some form of heat pump would be necessary if the steam were to be used effectively for feed heating.

Mr. I. V. Robinson said that the paper dealt more with the economy of high-pressure steam than with its use. Most engineers believed that economy was served by the adoption of increased pressures, but it was to be regretted that little information had so far been published regarding the actual use of high steam pressures. American engineers in that respect were more liberal than those in this country. It would be very useful if information could be given on such points as the design of flanged joint used on the steam pipes of high-pressure plants and on the extent to which the load was divided between the high-pressure units and the low-pressure units working on the high-pressure exhaust. In the stage efficiency curve given by the authors in Fig. 7 of the paper he thought that the efficiency of 65 per cent. assigned for the high-pressure stages was too low. Turbine makers could, he thought, undertake in the case of large units to reach 75 per cent. In this country a plant using 450 lb. steam was at work, but such a pressure would not be considered high from the authors' point of view. The Bradford high-pressure plant now being laid out would work with steam at 11,000 lb. pressure and would have a boiler generating 94,000 lb. of steam per hour. The high-pressure unit would consist of a 2500-kilowatt geared turbine running at 5000 to 6000 r.p.m. Its exhaust at 210 lb. pressure would be used to drive a 7500-kilowatt low-pressure set. Concluding, he asked whether the authors could give a simple formula for the average adiabatic heat drop of, say, 100 lb. of steam when, for example, 8 per cent. of the heat drop was taken out at the first tapping, 7 per cent. at the second, and the rest sent to the condenser.

Sir Robert Dixon, remarking that the future of the steam engine undoubtedly lay in higher pressures and higher temperatures, contended that the most important part of the paper was that dealing with the conditions to which the boiler heating surfaces were subjected. Admiralty experience indicated that the creep strength was very much less than those shown by the authors' curves. He particularly doubted whether nickel-chrome alloy would withstand the stress at the temperatures given by the authors. Regarding the margin of strength possessed by the metals at various temperatures, the authors might, he thought, have laid more stress on the fact that the results were only estimates and were based on an uncertain factor, namely, the amount of heat radiated in the furnace. No account seemed to have been taken of the heat conveyed by direct convection, which was probably about 30 per cent. of the total. He entirely disagreed with the authors' suggestion that dual condensers were necessary with high-pressure steam. The dual condensers of the King George V. were employed only to provide a margin of safety. There was no necessity for other than ordinary condensers if modern condenser tubes were employed. The authors referred to the scaling of the boilers, but if salt detectors were used there was no need to perform the operation. Oil was much more dangerous in high-pressure installations than salts in the water. The slightest film of oil on the boiler tubes would lead to overheating.

Mr. R. H. Parsons (editorial representative of THE ENGINEER on the Continent) said he had come over from Brussels specially to hear the paper, and he had not been disappointed. The paper was technical and scientific, and he did not propose to meet the authors on their own ground; Mr. Martin and Mr. Robinson had done so, and it was safer to leave it to them. There was a point, in connection with Figs. 1 and 2, on which he would be glad if the authors could give him some explanation. Those figures gave the reduction of strength by creep for various materials. In the case of the nickel-chrome alloy in Fig. 1, zero strength reduction was shown at about 800 deg. Fah., which meant, he presumed, that it had at that temperature the same strength that it would have in an ordinary direct test. The same alloy, at the same temperature, in Fig. 2, had a direct strength of 46 tons and a creep strength of only 34 tons, equivalent to about 25 per cent. reduction in strength. He might have misunderstood the diagram, but he would like an explanation of it. With regard to the question of high-pressure boilers, generally the first difficulty encountered was the construction of the drums. The Langerbrugge boilers, which were running at 800 lb., had riveted drums—1¼in. plates—but general practice tended towards solid forged drums, even at pressures very much below 800 lb. Between July, 1922, and December, 1925, Messrs. Krupp supplied 322 drums forged from the solid for pressures up to 1700 lb. per square inch; 170 of them, or more than half, were for boilers and the other half for high-pressure chemical work. Such figures gave an idea of the extent to which that method of manufacture of boiler drums was developing on the Continent, because the details he had given were for one firm alone. Another process which was rapidly being brought forward consisted of the manufacture of drums by welding. He had seen the process in operation, and, for himself, he would not have the least hesitation in employing a welded drum for those pressures, if it was manufactured by the firm in question. There was nothing astonishing about the method, which was carried out years ago by Piggotts, of Birmingham, on thinner material, but it had now been developed by Messrs. Thyssen for plates up to 90 mm., or 3½in. thickness. After being welded, the drums were reheated entirely in a furnace, and then re-rolled to

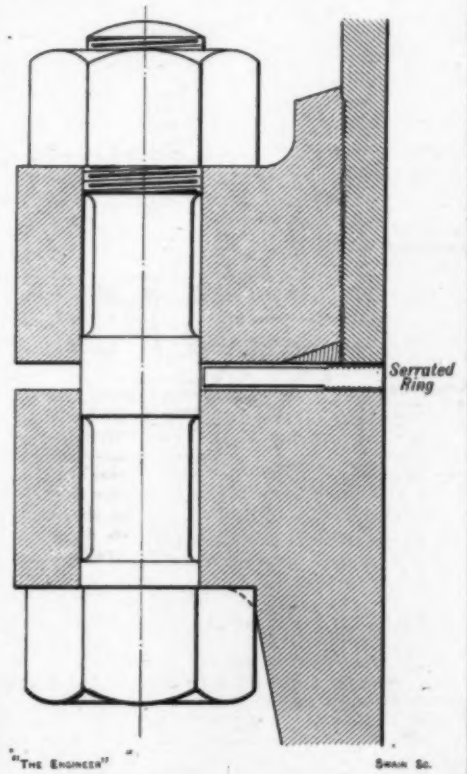


FIG. 1—HIGH-PRESSURE STEAM PIPE JOINT

get them nice and round. The ends were then faced off and the cylinder tested at a very high pressure in a proper pipe-testing machine, and, if found to be all right, the ends were heated and closed in. The drums were then put under an internal hydraulic pressure which strained them above the elastic limit, and very careful measurements of their deformation were made. Finally, the drums were re-annealed in a furnace. A drum which would stand that treatment should be a fairly satisfactory drum. He might mention that the price of such drums was about two-thirds of the price of the solid forged drum, and he believed that to the end of 1926, 3287 welded drums for pressures up to 850 lb. had been supplied by Messrs. Thyssen. Turning to the question of the tubes, the authors dealt largely with the question of temperature effects, and had mentioned the possible danger of decomposition by the steam. He did not believe that any power station in the world was run at higher temperature than Langerbrugge, which, day in and day out, ran at 450 deg. Cent., and everyone who had anything to do with power houses knew that superheaters varied above and below the normal. He had quite recently asked Mr. Herry about this question, and Mr. Herry replied that no temperature difficulties of any kind were experienced, and he gave him (Mr. Parsons) a piece of a superheater tube that had run for something like 5000 hours at 840 deg. Fah.—normal working temperature—and under a pressure of 800 lb. The temperature had, in fact, exceeded 900 deg. Fah. more than once, and on one occasion the pyrometer registered 1030 deg. Fah. Nothing, however, happened, and there was no failure at that time. The tube was in quite a satisfactory state, notwithstanding the conditions named. He might add that there had been no trouble with pipe joints at Langerbrugge, and he believed that not a single pipe joint had had to be re-made since the station started up over a year ago. The speaker then illustrated by a sketch on the blackboard the type of joint used at Langerbrugge. This joint was illustrated in our issue of August 6th, 1926, by the courtesy of Babcock and Wilcox, Ltd., and we reproduce the illustration then given—see Fig. 1. The pipe flanges are both faced off square, and between them is inserted a disc of mild steel about ¼in. thick, machined all over and bored to the pipe diameter. On each of the faces of the disc is a series of sharp-edged V-shaped concentric ridges, as shown in the figure. The bolt holes are reamered in position and fitting bolts are used, turned down on their bodies, as shown. The ridges forming the actual joint were smeared with a graphite paste before the ring was inserted.

No mention, Mr. Parsons continued, was made in the paper of gauge glasses, which were quite a serious matter. At Langerbrugge all kinds of gauge glasses had been tried, the life of some of which had been very short. They now used glasses made of Pyrex, a fused silica. They were quite cheap and would run for about a month, and only cost a few francs to replace if they failed. Messrs. Dewrance had produced a sort of high-pressure gauge glass in which the glass was protected by mica from the action of the water, and it would probably be all right. It had actually been in use; but the others were more visible.

The authors had referred to the question of reheating. It was rather noticeable that neither Mr. Herry nor Mr. Roles, of Bradford, had gone in for reheating. Mr. Herry had put up the initial steam temperature to 840 deg. Fah. simply to avoid reheating, so that after the steam left the high-pressure drums it went straight into the main at about the same superheat as the ordinary steam in the main. Mr. Roles only used a temperature of 800 deg. Fah., but the initial pressure was very much higher, and nearly all the superheat would be lost by the time the steam reached the mains. The whole question of reheating in turbines was a difficult one mechanically, because of the trouble of taking a big pipe of steam into the boiler-room, heating the steam up, and bringing it back into the turbine-room. There was a way, which he was informed would not work, but theoretically it was sound, which he would sketch on the blackboard.

Referring to a sketch which he made on the blackboard, Fig. 2, Mr. Parsons said that if steam were passed

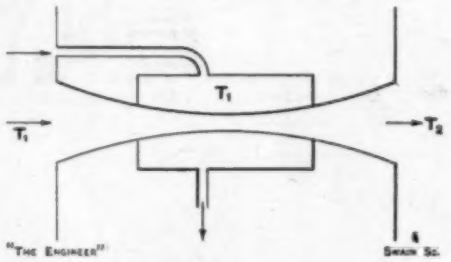


FIG. 2—SUGGESTED RE-HEATER

through the ideal Venturi tube, with no frictional or eddy losses, the original pressure and temperature would be restored at the exit of the tube. At the throat, however, where the velocity was high, the pressure and temperature were both much reduced. The throat therefore would contain steam in a temporarily cooled condition. Hence if the throat were jacketed by steam at the original temperature, heat would enter the steam at that point, with the result that the steam at exit from the tube would be hotter than it was on entering. Apparatus such as the speaker sketched could be used in series, with the result that steam could theoretically be heated to any temperature desired, merely by using the heat of a part of it. There was nothing like perpetual motion about the idea, and no laws of thermodynamics were infringed. The process, thermodynamically, involved a loss of available energy; in other words, more useful work could be got out of the steam if the process were not adopted. But in the case where it was required to superheat steam without bringing any furnace or other external source of heat into the business, the idea might be worth while. The action was automatic, and it might be taken for granted that when anything happened by itself in Nature, there was a loss of available energy.

Mr. Parsons stated that Mr. Herry had authorised him to tell the members the results at the Langerbrugge plant, and the following was a rough translation of Mr. Herry's statement:—"The high-pressure plant was started up about twelve months ago, and put into service according to a programme of operation carefully prepared ten days in advance. It has now been running for a period of more than 5000 hours by day and three months day and night, so that the time has come when it is possible to express an opinion and give the result of experience. Two incidents only, neither of which was due to the high pressure, have caused a temporary involuntary stoppage of the plant, namely, the necessity for an alteration of the feed pumps, which became evident when they

were first tried with hot feed water, and an inspection of the alternator. As regards the boilers, four identical accidents have happened when starting up, namely, the bursting of a superheater tube. These accidents always took place before the normal working pressure had been reached, and were probably due to pockets of air and to getting away the fires too quickly. A circulation of steam through the superheater before putting the boilers in service has overcome the difficulty." Interposing, he might say that the boilers were twenty tubes high, and there were only five tubes between the superheater and the fire. "The tightness of the joints, valves and pipe lines has always been perfect. The erection of the installation was indeed a real piece of fitting work. The tightness of the drum and of the safety valve has been defective. Drums forged in one piece could be substituted with advantage for riveted drums for such a pressure." As a matter of fact, Mr. Parsons remarked, the leakage was exceedingly slight. "The water level indicator has been tested on several occasions. Accidental superheats up to over 500 deg. Cent. (932 deg. Fah.) have been registered—once even 560 deg. Cent. (1040 deg. Fah.)—and have not apparently injured the material in any way. It is therefore legitimate to conclude that the operation of installations of the order of 800 lb. with 840 deg. temperature presents no special difficulty, and that the construction of plants for a higher pressure and higher steam temperature are realisable to-day. It was the consideration of all-round economy which

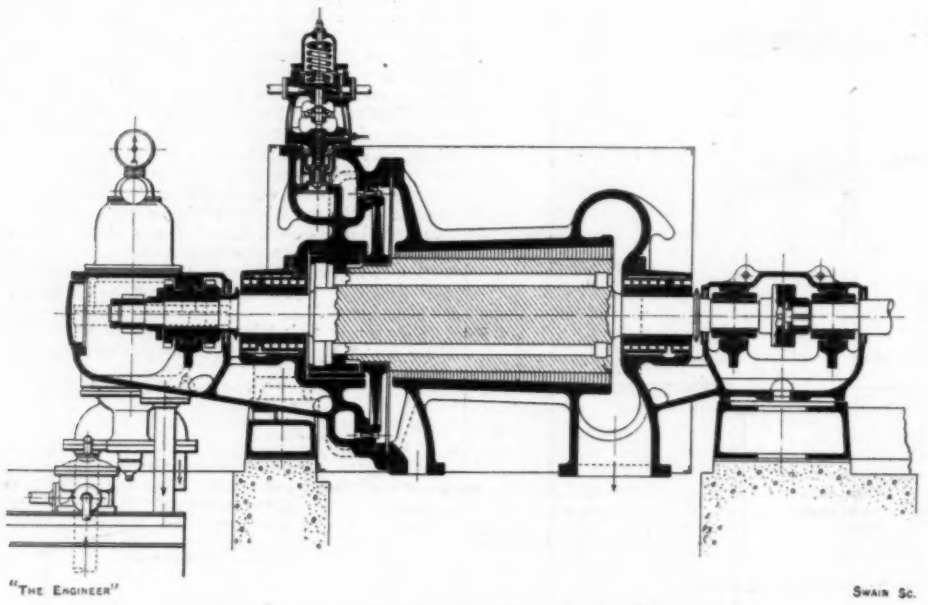


FIG. 3—PROPOSED TURBINE FOR LANGERBRUGGE POWER STATION

was the deciding factor in the Langerbrugge installation. The expense was strictly limited to the average price per kilowatt of the plant already installed namely, about 1000f. for the kilowatt rating (in 1923). The power is more than doubled as compared with the area required for plant at 14·5 kilos. (226 lb.). The useful power is quadrupled. The economy of space of sets of greater capacity will be still more notable. The daily saving of coal is very noticeable and the Centrales Electriques des Flandres have decided, in principle, that the next enlargement of the Langerbrugge station shall consist of a turbine of 6600 kilowatts at 50 atmospheres, 450 deg., and three boilers, each with a capacity of 45,000 kilos. (99,000 lb.) steam at 56 atmospheres and 450 deg. Cent."

By Mr. Herry's courtesy, he was able to show a slide illustrating the type of turbine which it was proposed to use—Fig. 3. The type now in use differed from that shown on the slide, being an impulse machine with two wheels, which had been illustrated in THE ENGINEER for June 4th, 1926, and of 2000 kilovolt-ampères, whereas the machine on the slide had a rated capacity of 6600 kilowatts, when taking steam at 800 deg. Fah. and 800 lb., and exhausting against a back pressure of 300 lb. to the inch.

The public was not quite aware how many of those high-pressure steam plants were in use. In the short amount of time at his disposal, he had compiled a list which contained the following particulars:—The Langerbrugge installation, that at Messrs. Sulzer Brothers (1565 lb.), Schmidts of Cassel (853 lb.), Borsigs (1420 lb.), Hanomag (1500 lb.), and three or four other firms, with regard to whose installations he was not quite certain. The Atmos people had two boilers, now finished, at Mulhouse, one of 6600 lb. just in service and another of 22,000 lb. for service shortly. The Humbolt people were developing turbines for those boilers, and showed one at the last Autumn Fair at Cologne. Research work was proceeding. It was not laboratory research, but making and testing—the best manner of carrying out research.

Mr. A. J. H. Fitt said that last year, on the Continent, he had noticed the tremendous advance being made with high-pressure, high-temperature steam plants. He had seen one plant of 2000 kilowatts capacity running perfectly satisfactorily with steam at a pressure of 55 atmospheres and at a temperature of 425 deg. Cent. (797 deg. Fah.). Process plants, he continued, provided a very attractive field for the use of high-pressure steam, but one of the great difficulties in such application would consist of keeping the process steam free from oil, scale and other foreign matter. Boiler fluids might be used to purify the water, but if they were it was essential to install efficient separators in the pipe lines. He seconded Mr. Robinson's view that the authors had assigned too low a stage efficiency for the high-pressure stages. With high pressures the loss produced by wetness in the steam was very important, and he regretted that the authors had not dealt with it. The inserted serrated disc type of pipe joint, as described by Mr. Parsons, was, he said, quite efficient. Welded steam pipes were being extensively adopted, and in the future might represent standard practice. The necessity for flexibility in the steam pipes carrying high-pressure steam from the boiler to the turbine had been mentioned by the authors and was very important.

Professor Mellanby did not do more than express his thanks to those who had taken part in the discussion. He would, he said, have himself liked to have given practical details of high-pressure plants, but the paper was already on the long side, and he held that it was his part to deal with the more theoretical aspects of the subject. He hoped that other members would contribute practical information as Mr. Parsons had done.

The discussion was adjourned and will be resumed at the annual general meeting of the Institution in February.

The Internal Combustion Locomotive.

(By an Enthusiast.)

THE internal combustion engine, using cheap residual oil as fuel as the prime mover for locomotion on railways made very considerable progress during 1926, but such progress was rather in an educational sense than in the actual visible application. Thus it may be said that the chief mechanical engineers of railways all over the world have been studying the engine and its application, its economy and method of employing it on the particular duties of their own railways.

The economy of the oil engine *per se* is so generally acknowledged that there has been no particular need for educational work with regard to it, but such problems as whether it would stand up in service, its cost of upkeep, how it should be applied, and what particular duties it is most suitable for, have received close inquiry, and a general clearing up of the uncertainty on these points has resulted.

In the employment of the engine the main consideration has been the question of transmission, and here an astonishing variety of methods has been evolved. In some cases proposals have gone no further than design, but several others have actually been put into use. They may roughly be divided into Mechanical, Hydraulic, Electric, Pneumatic or Gaseous methods. The general interest of engineers in the subject has been indicated by several papers dealing with methods of transmission.

In actual locomotives the best-known practical examples are the Lomonosoff designs for Russia, of which the first, with electric transmission, has been in service for some time, doing good work, and the second, with a toothed gear drive, has done its preliminary running, and is now being adjusted for final test before being put into regular railway service.

The examples of the hydraulic class are of smaller power, and are found in rail-cars. They are either of the piston, turbo-type, or combined piston and gear type. The use of compressed exhaust-gas or steam, air, &c., for transmission has not made much practical progress.

In powers less than locomotive size the installation of the oil electrical method on the Canadian National Railways is the most outstanding example. It now almost appears that the preferred method, at any rate in the immediate future, will either be electrical or mechanical, with a leaning towards the former.

The use of a high-speed oil engine has so cut down the electrical generator weights, &c., that when the latter is coupled with a variable-speed engine, it is difficult to show any material gain by the use of other systems, except the mechanical, which aims at an increased transmission efficiency and a rather lower first cost. But the difference is not by any means so great as would appear, and the great flexibility resulting from the use of an electrical transmission may be said to quite balance up the advantages of the other methods just enumerated. Furthermore, the road shocks which are so very material in locomotive work, and which cannot be adequately compared with those met by a motor lorry on the road, render the risks with pure gearing greater than with electrical. Moreover, for passenger service the greater possibilities in acceleration, by multiple working, are great assets of the latter.

Inter alia, it may be said that in the use of the internal combustion engine for motor rail-car work in America, the difficulty of making a geared transmission stand up to over 150 H.P. has led to the hardening of the opinion that the electrical method is the better. It may be, however, that there will be some division of use for both, and other methods in certain limited fields; for instance, for slow-speed heavy freight work the all-gear system may come into use. Nevertheless, experience to date does definitely indicate that there is no need for the Chief Mechanical Engineers to await the advent of some ideal mechanical gear, for the electric, with its vast field of practical experience is equal to tackling most problems.

Combination systems using gaseous means for transmission—that is to say, a compressor on the main engine, the compressed fluid operating driving cylinders coupled to the wheels after the manner of the ordinary steam locomotive—form an interesting type, of which not much practical experience has been gained.

When steam is used in conjunction with oil, as in the Still engine, of which a notable example will be the Kitson-Still locomotive, many economic advantages are looked for. Only experience will show whether the inevitable complications of this system will prevent anything but a limited application of it in practice.

In the use of the internal combustion engine for rail locomotion, three grades or classes seem to emerge—Motor coaches, motor trains and locomotives. The motor coach is well known and well tried, and is equivalent to a rail bus, both in its design and in the class of service that it provides for. In this country, the use of steam for this purpose is predominant, though a certain number of internal combustion engines using petrol or paraffin are in use. In America and Australia, on the Continent in various parts as Norway, Sweden, Germany, Holland, France &c., there are many examples in constant use.

For this service the oil engine is being considered and applied in a limited degree, but not so far, to a great extent, partly because the design of the engine required, which usually does not exceed 100 H.P., presents some difficulty, mainly owing to its relatively high first cost.

In this class of car, various systems of transmission are in use, and whilst the electric is the preferred one in America, it cannot be said that this is clearly so as yet in Europe, mechanical gears being principally used. In certain cases, hydraulic transmission is preferred, as, for instance, the Swedish gear which uses a species of centrifugal pump and turbine motor.

The second class, namely, motor trains, is really much more important and economical in its bulk results. It affords to the railway engineer very great interest from the wide possibilities opened out by its use. The experience with oil engine electrical sets in Canada on the Canadian National Railways has indicated that they can be run in parallel or multiple. Thus, one engine mounted in the baggage end of a combination car, capable by itself of hauling up to 150 tons, can, when worked in multiple with another similar set, form a 300-ton train, quite equivalent to most of the services in this country. Such a combination would be able to run all the second-class express services, and if greater engine power were installed, some of the first.

The method of control is quite simple, the whole operation being carried out by a variable-speed engine, practically without the use of any electrical resist-

ances, or controls of that type, the generator being coupled straight to the motors.

Referring to the actual application of the engine, those which are now in service on the Canadian National Railways may be said to exhibit the most advanced development of the type, and the later sets now being constructed have taken advantage of the accumulated experience gained with the first. Most other applications have involved the use of semi-submarine constant-speed types.

It is interesting to know that some of the first sets (Beardmore) of the Canadian National Railways have now been in service over fifteen months, and have totalled over 80,000 miles, and it is anticipated that they will run 150,000 miles without being shopped for the general overhaul of the engine.

Very many practical points have been learnt in the application of the engines on this railway, and full use has been made of them by the far-seeing management. Thus an educational system for training men—to provide for the development in the use of these engines—has been established, most complete working instructions have been got out and other recorded knowledge has been organised for the use of the *personnel*. This very wise policy results from the decision of the railway company to use only the oil engine as its motive power in the future. For it there is being constructed one of the largest locomotives in the world. It will have oil engines and develop a tractive effort of 100,000 lb., and will haul either the slowest freight trains or the fastest expresses.

The use of the oil engine has revealed the possibility of long running hours, equivalent to those of the electric locomotive. The economy in labour secured is frequently as great as that resulting from reduced fuel consumption. The low consumption of water, apart from saving in cost, renders the type very suitable for hot countries, districts with very bad water or very long railway runs, without change of locomotive.

It is anticipated that with the use of such locomotives, the number required in certain cases to work long express services may be only one-fifth that of steam engines, and railway engineers with this fact in mind can see what enormous economies will grow out of the use of this power, as it becomes better understood, and its possibilities more thoroughly appreciated.

The cost of service on the Canadian Railways, about one shilling per mile, indicates that in this country the railway operation by oil engines would work out at not much over one-half of what is now current.

At the present time the locomotive engineer, whilst at first doubtful as to the service that can be put up by oil locomotives, appears to be concentrating upon its apparent high first cost, which seems to be occasioning him undue concern, particularly when compared with steam engines. But careful investigations have shown that, taking into account the much greater running time possible, the prime cost is not high per mile run, and the figures of economy are so great as to provide for it comfortably.

The Beardmore "Typhoon" Aero-Engine.

THE peculiar requirements of the aeroplane have led to a multiplicity of curious and interesting developments and inversions of ordinary internal combustion engine practice. A radial arrangement of the cylinders round a common master crank was among the first developments in the evolution of the aero-engine, and was quickly followed by an early instance of inversion, when, as in the Gnome engine, the crank shaft was held stationary and the cylinders caused to revolve round it. What may be called a semi-inversion occurred, or was proposed, soon afterwards, namely, the gearing of the cylinders and crank shaft together, so that the one element would rotate in one direction and the other in the opposite direction.

From these and other early examples have sprung a host of inspirations and improvements. To-day engines are in existence which are so compact and flat that they can be housed within a thick wing section. The spur to development provided by aeronautics is, however, perhaps to be seen at its highest at present in the efforts now being made to produce a satisfactory compound expansion internal combustion engine.

An interesting example both of development and inversion is to be found in the Beardmore "Typhoon" aero-engine. This engine is of practically the same design as the Beardmore "Cyclone" engine, which we illustrated and described in our issue of December 24th, 1926. The outstanding difference is that it is turned upside down; that is to say, its crank shaft is above instead of being below the cylinders. The engine is described as a six-cylinder inverted petrol engine of 800 to 1000 horse power, but beyond saying so, we are not at liberty to publish anything about its detailed design. A few general remarks may, however, be made concerning the outstanding virtues claimed for the engine as a whole.

Most aero-engines of about the power of the "Typhoon" would develop their output in anything up to twelve or sixteen cylinders. The Beardmore engine has only six, and from that fact, it is claimed, the advantages resulting are simplicity in operation and maintenance, reduction in the number of moving parts, and an increased economy of fuel and lubricating oil. We understand that a consumption of 0·46 lb. of fuel and 0·01 lb. of oil per horse-power hour can easily be attained.

The inversion of the engine has several important consequences. In an ordinary engine installation a considerable amount of weight is involved in the structure required to mount the engine on the machine framework. In the "Typhoon" the crank case lying above the cylinders has itself been designed to take the place of a good part of the supporting structure, and as a result weight is saved, and some complexity is avoided. With an upright cylinder engine of the usual design the engine structure projecting upwards above the crank shaft may cause considerable obstruction to the pilot's forward view, and at the same time present a fairly large head resistance area. The position of the centre line of the crank shaft is fixed by aerodynamical considerations, which require the pull developed by the screw to be applied along a certain line. Freedom to place the crank shaft below this line can be obtained by a resort to the use of gearing between the shaft and the screw. In general, such gearing, if it is employed, effects a reduction of speed, as well as permitting a displacement of the crank shaft below the line of pull, but machines have been designed, for example, some German machines produced during the war, in which gearing of one-to-one ratio has been used between the engine and the screw solely in order to secure a lower position of the engine. It is clear that with the smaller side of the engine above instead of below the crank shaft, as in the "Typhoon" engine, the crank shaft can be placed on the line of the required pull without obstructing the pilot's forward vision. Again, the bulk of the frontal area presented by the engine is not added to, but coincides to a considerable extent with, the frontal area presented by the body of the machine. The inversion of the engine, in fact, permits it to be built into the outline of the body and cowled to continue the body shape in a manner hardly realisable with the usual upright cylinder engine.

The "Typhoon" is not the only example of an "upside down" aero-engine. Among British engines the Napier "Lion" has also been built in an inverted form. It may be well therefore to call attention to what would appear to be a mistaken view regarding an advantage which, according to some authorities, attends inversion. It has been stated in certain quarters that the inverted engine enables the centre line of the air screw to be placed high up without interfering with the pilot's field of vision, and, as a consequence, frees the designer from the hampering consideration of clearance between the tips of the screw and the ground. This argument would appear to be unsound. The centre line of the screw is fixed by aerodynamical considerations, and cannot be moved up or down to any extent to suit the design of the engine. With the height of this line fixed, the ground clearance is purely a matter of the diameter of the screw, and is not in any way affected by the disposition of the cylinders above or below the crank shaft. By the swinging of the cylinders from above to below the air screw axis, the obstruction of the pilot's view is reduced. The height of the air screw axis and the diameter of the screw are not, however, affected, and consequently the ground clearance remains unaltered.

On Monday of this week at Hamble, near Southampton, we witnessed the flight of an Avro "Aldershot" bomber, fitted with a Beardmore "Typhoon" engine. The machine had not been specially designed to take the engine, and the cowling was obviously of a make-shift order. Nevertheless, the manœuvres performed with the machine, particularly the landings, provided good proof of the qualities of the engine, even allowing for the fact that the machine was in charge of a pilot, Mr. Hinkler, of great skill and experience.

Water Power *versus* Oil Engines in Bulgaria.

A FEW years ago the idea of the electrification of the whole of the country by means of powerful hydro-electric stations was very popular in Bulgaria. The "inexhaustible riches" in water power of Bulgaria were particularly vaunted, and the State advanced considerable sums to water syndicates and corporations founded in many parts of the country. Since then, however, says a writer in *La Bulgarie*, it has been necessary to moderate many of these dreams, and it may now be said that Bulgaria is not the country of water power that had been supposed. She has not, like France, Switzerland, Sweden and Italy, enormous reserves of water for the dry summer months in the form of glaciers and eternal snow in her mountains, nor does she possess great rivers fed by wooded mountains, such as the Rhone or the Rhine. Most of the rivers in Bulgaria are almost dry in summer, and on an average a total of not more than 1,000,000 horse-power of hydraulic energy is said to be available. It is recognised that encouragement should be given to towns which confine themselves to obtaining the power for their electric lighting and their local industries from the rivers in the valleys where they are situated. But as soon as it is a question of transmitting to a certain distance the electric energy thus obtained the difference between the cost price of the kilowatt-hour produced by a waterfall and that produced by a thermal station lessens considerably, for the construction of the system of distribution lines often costs two or three times more than the construction of the central hydro-electric station. In cases such as these, it is argued, it is more economical to build central thermal stations.

During the last few years many power stations have replaced their steam engines by heavy oil engines and use liquid fuel in place of coal. Professor Danailov has protested in the *Slovo* against this practice; he points out that Bulgaria is rich in coal still to be exploited, while she has no native liquid fuel. She is therefore obliged to purchase heavy oils abroad when she uses them in her industry, to the great detriment of her balance of trade and the quotation of the lev. On the contrary, if she retains the steam engine she will be contributing to the development of her coal industry, which is greatly desirable. The professor concludes, therefore, that it is necessary to place heavy import duties on heavy oil engines and foreign liquid fuels entering Bulgaria.

In reply to this contention an article appeared in the same journal by the engineer B. Radev, who admitted that it was true that many Bulgarian towns used modern heavy oil engines for their electric lighting, since they offered the most practical and economical form of power; besides which, in many towns they are the only possible means of producing electric light. These towns number fourteen at present and possess about 300,000 inhabitants, or 75,000 families. Statistics show that each provincial family in Bulgaria consumes for lighting purposes an average of about 60 kilowatt-hours a year, so that these 75,000 families consume annually about 4,500,000 kilowatt-hours. In order to produce that total it is necessary to use about 1,600,000 kilos. of liquid fuel at a price of two or three leva a kilogramme, making a value of 3,700,000 leva. The cost of about 35,000 kilos. of lubricating mineral oil used for oiling the motors—about 500,000 leva—must be added to that figure. Apart from these fourteen large central electric stations belonging to the municipalities, there existed in Bulgaria, continued M. Radev, many other privately owned electric stations which use heavy oil engines. Furthermore, eighteen other Bulgarian towns or co-operative companies had decided to introduce electric lighting into their districts in 1927, and they would also use heavy oil engines; 250,000 inhabitants, forming 62,000 families, would profit from this transformation. At present they used for the lighting of their dwellings about 2,800,000 kilos. of paraffin a year, valued at 11,200,000 leva. When electricity replaced paraffin in those districts it would only be necessary to import from abroad 1,350,000 kilos. of mineral fuel and 30,000 kilos. of lubricating oil, valued at 3,200,000 leva; at least 8,000,000 leva a year would therefore remain in Bulgaria. If high import duties were placed on imports of heavy oil engines, mineral oils and their products, electric lighting in Bulgaria would be much dearer and many families would probably be obliged to refuse this luxury and return to the use of the paraffin lamp, which would add considerably to the money spent abroad by Bulgaria on paraffin.

M. Radev urged in conclusion that in Bulgaria the *rôle* of the State should not consist in favouring any one category of electric power stations, but in leaving each organisation to choose for itself the system it finds most profitable in view of the special conditions in the locality. The only thing the State ought to do, he maintained, should be to demand of each new municipal electrical enterprise to make its choice in such a way that from the first or second year of its working it would be able to meet expenses, to pay interest on the capital invested, and provide an annual redemption sum, or be deprived of all credit or other form of encouragement from the State.

SIXTY YEARS AGO.

THE failures and blunders of our Army commissariat during the Crimean War were so great and conspicuous that it became a common jibe to say that Sebastopol might have been taken sooner and more cheaply by contract than by the Government's forces. It became the fashion, in fact, at that time to abuse all official management, and to extol commercial arrangements in every way above those made by Government Departments. Ten years later, however, the tide turned. According to a leading article in our issue of January 25th, 1867, there were at that date many people who desired to see the management of our railway and telegraph systems placed in the hands of the Government, and our gas and water supplies turned over to the municipalities. In connection with the supply of water, there was a particularly strong and growing demand that it should, as we put it, "be financially disburdened of the necessity for paying a profit to joint stock companies." Equally strong was the demand that the supply of water should everywhere be constant and not intermittent, a system strongly favoured by the water companies of the time. According to our article, the average consumption of water in London was at that date about 30 gallons per day per head. Among the poorer classes, however, the mode in which the water was supplied resulted in an average consumption of only 5 gallons, and even of this quantity at least one-half was wasted by leakage from the "wretched butts and butter tubs" in which it was stored. In addition, the storing of the water which was a necessary feature of the intermittent supply system was blamed by medical authorities for the outbreaks of cholera which occurred with frequency. We strongly supported the demand for a continuous water supply. It was, we argued, wholly a question of satisfactory fittings. Under the intermittent system the fittings required were complicated, but no great perfection was necessary in their construction and working. With the maintenance of a constant head in the mains, the avoidance of enormous waste would demand the use of nothing but first-class fittings kept in perfect order. London, Plymouth, Devonport, Shrewsbury and Oxford, to name only a few important towns, still clung to the intermittent system, but the manufacturing centres in the North, including notably Manchester, Newcastle, Preston, Stockport and Halifax, were leading the way with a constant supply. The constant supply system where it had been adopted had, it was found, resulted in no increase in the daily consumption if care were taken to install sound fittings and to adopt stringent regulations regarding their proper use. The experience of Newcastle in this respect may be recorded. In some districts of that town the consumption was as high as 80 gallons per head per day. Investigation revealed that the chief source of the excessive consumption lay in the misuse of water-closets, the handles of which were frequently propped up to give a continuous flush. The adoption of valve cisterns which could not be propped up to give a constant run led to the consumption being reduced by something like 50 per cent.

IT is stated in the *Iron and Coal Trades Review* that a seam of coal has been struck in the boring operations which were recently commenced at Crosby, near Maryport, by the Birkby Colliery Company. The coal is believed to be the Ten Quarter seam. It has been discovered not very far away from the old Rosegill pit. Forty years ago this was a very important part of the Cumberland coalfield, and both Rosegill and Crosby Collieries were noted for the quality of coal raised from the Ten Quarter seam.

A De-ferrating Plant at a Sussex Waterworks.

WE were enabled a few days ago to inspect and witness in operation the Horsted Keynes pumping station of the Mid-Sussex Joint Water Board, which has recently been completed and brought into use, and which has many points of exceptional interest to waterworks engineers, especially the method of de-ferrating the crude water.

The works have been carried out to the designs of the Board's chief engineer and manager, Mr. F. Martin, M.I. Mech. E., who, in his search for a further source from which to provide an urgently required additional supply of water, had for a long while given attention to a spring known as the "Holy Well," which has a daily yield of some 500,000 gallons, and rises practically to ground level. The water flowing from it was known to be of exceptional purity, from both the organic and bacterial points of view, and to be exceptionally soft, but unfortunately it was very heavily charged with iron in solution and also with carbonic acid. It was, and is, in fact, a chalybeate water, as is shown by an analysis made in 1921—see Table I :—

TABLE I.—*Physical, Chemical and Bacteriological Data.*

Turbidity	Turbid from presence of oxycarbonate of iron
Colour	Faint yellow when filtered
Odour	None
Reaction	Faintly acid, PH = 6
Total solids, 180 deg. Cent.	19·5 per 100,000
Chlorine in chlorides	2·1 "
Nitrogen in nitrates	0·0 "
Nitrites or free chlorine	Absent
Hardness—	
Permanent	3 deg.
Temporary	6 deg.
Total	9 deg. (Much due to carbonic acid)
Lead, copper, zinc, iron—	
Iron in solution	0·40 per 100,000
Iron in deposit	0·50 "
Total	0·90 "
Free ammonia	0·0120 "
Albuminoid ammonia	0·0024 "
Oxygen absorbed—	
In 3 min. at 37 deg. Cent.	0·200
In 3 h.	0·220
Number of bacteria per cc.—	
On gelatine in 3 days	74
On agar in 24 h.	0
The *Bacillus coli*	— 100 C.
The *Bacillus enteritidis sporogenes*	— 100 C.

Report.—This is a water of the highest degree of organic and bacterial purity, but which cannot be used for domestic purposes on account of the quantity of iron present. It really is a medicinal water, but by cascading to aerate it and sedimentation or filtration, it could be made into an excellent water for all purposes.

Acting on the information contained in this report, which confirmed the conclusion at which Mr. Martin had previously arrived, steps were at once taken to acquire the spring and the surrounding land, and after some trouble and delay possession of the spring and of some 16 acres or so of land round it was obtained.

The spring rises a short distance off Keysford-lane, near Horsted Keynes, some 4 miles from Haywards Heath. Before it was tapped it flowed into the Cockhaise Brook, as seen in Fig. 1. It may be mentioned, as a matter of interest, that its waters have long been renowned in the district for their medicinal virtues. They are associated with picturesque legends, sometimes of the Devil and a scorched nose, and sometimes of miraculous cures by supposed Divine aid, and are looked upon as furnishing a sovereign remedy for many ailments, both human and animal. Even now, there are many living in the vicinity who prefer, or say they do, to drink the water before rather than after it has been de-ferrated.

In order to preserve the spring from contamination by surface water, a cylinder, made up of cast iron segments, was sunk round it down to the rock, from a deep fissure in which the water rises. The bottom of this cylinder was concreted, save where the fissure came, and the outside of the cylinder surrounded with puddled clay. Furthermore, the cast iron segments were taken well above the ground line, so that all chance of pollution has been eliminated.

From the spring the water flows by gravity through a 12in. pipe, from which there is a branch fitted with sluice and reflux valves to provide an overflow into the brook, into a reinforced concrete collecting and aerating reservoir, which measures 104ft. by 104ft., and which has a capacity of some 200,000 gallons with the water standing 3ft. deep. There, a certain amount of aeration and oxidation takes place, the action being very rapid. As it enters the reservoir and for a yard or so from the inlet, the water is quite clear, but the whole of the rest of the reservoir is cloudy, and samples of the water taken from anywhere in it are deep yellow in colour and cloudy. Some of the oxidised iron is no doubt precipitated in the tank, and, in time, it will have to be removed, but no trouble from that cause has hitherto been met with.

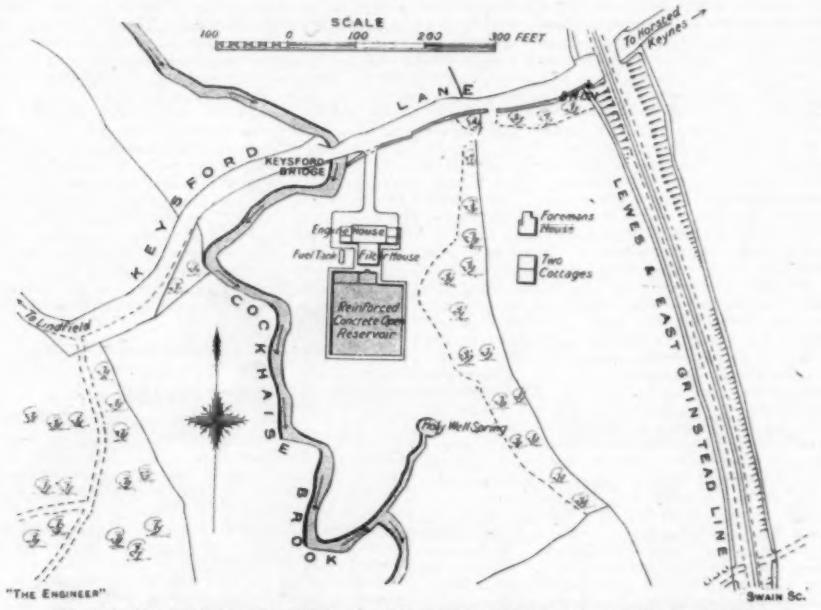


FIG. 1—PLAN SHOWING POSITIONS OF HOLY WELL SPRING AND PUMPING STATION

The operation of treatment which will be more readily understood by the aid of the drawing in Fig. 2, are as follows :—First of all, the water flows by gravity to the aerating and collecting reservoir, from which it is pumped by a low-lift pump and forced through a number of very fine spraying nozzles arranged above a small concrete tank, which adjoins the collecting reservoir. From this tank the aerated water falls over a weir to a sump, from which a medium-lift pump draws and delivers it under pressure to a battery of mechanical filters, the tops of which are kept charged with compressed air. The outlets from the filters are connected to a clear water main, which is connected direct to the suction of a high-lift pump, which forces the water at high pressure through some 7 miles of 12in. main to consumers, any excess quantity going to the Board's Balcombe reservoir as relief and storage.

That, in broad outline, is the treatment. The plant by which it is effected is noteworthy in several respects. The anticipation of the engineer has been amply borne out. By spraying the water through quite simple nozzles, the carbonic acid is dissipated and the iron effectively oxidised, the final oxidisation and elimination of the iron taking place in the mechanical filters.

In an analysis made of a sample of the treated and filtered water taken at the pumping station—some of the figures of which we quote below—the iron figure is given as being 0·002 parts per 100,000, the raw water figure being 0·90 parts per 100,000. Furthermore, we may say that an analysis of an average of a whole day's supply of filtered water gave the iron figure as 0·0015 parts per 100,000. The analyst's remarks on the water are as follows : "The water is in every respect excellent, pure and wholesome and suitable for a public supply. The iron may be said to be entirely removed. It certainly far more than complies with the contractor's specification." Some of the figures are given in Table II.

In describing the equipment of the pumping station, we may say at the outset that the pumping plant is in duplicate, and that, as all corresponding parts in the two sets are identical, it will only be necessary to refer in detail to one set. The three pumps for the three separate duties, to which we have referred, have their spindles all in line, are all driven by one engine, all run at the same speed, and they are all in operation at the same time. The motive power is obtained from a three-cylinder 165 brake horse-power vertical cold-starting airless-injection crude oil engine, supplied by Ruston and Hornsby, Ltd., of Lincoln, who were contractors in chief for the pumping plant and its auxiliaries, which will be mentioned in due course. The engines are of the makers' standard pattern and call for no special description as our readers are familiar with them. We are authorised by Mr. Martin to say, however, that they have operated most successfully ever since they were first started, as indeed have the pumps which were made by Mather and Platt, Ltd., of Manchester. The low-lift pump, called by its makers the "Lonovane," was guaranteed to deliver 535 gallons of water per minute under a head of 25ft. The pump supplying the filters—known as the "Medivane"—was guaranteed to deliver 560 gallons of water per minute ; and the third pump, the "Plurovane," was guaranteed to deliver 560 gallons of water per minute against a working head of 512ft. As a matter of ordinary practice, some 34,000 gallons are pumped per hour, or at the rate of 566 gallons per minute. The three pumps are mounted on one cast iron bed and their spindles are connected by rubber pin couplings to a single horizontal shaft, which is driven by belt from the engine. In order to reduce the length of drive, Mr. Martin introduced a Lenix jockey pulley arrangement, as may be observed in the illustrations of the interior of the pumping station, which are given on page 102. This arrangement, by which the distance between the centres of the engine and pump shafts has been brought as low as 9ft., has, we gather, worked well and given every satisfaction. We may say that the engine speed is 300 revolutions per minute and that of the pumps 1275, so that the ratio of the drive is as 1 to 4·25. The jockey pulley arrangements are shown so clearly in the illustrations that no description of them is necessary ; 16in. double leather belts without any stitching, their layers and joints being made with cement, are employed. They, too have, so we understand, given satisfactory results.

TABLE II.—*Particulars of Test of Treated Water.*

	Parts per 100,000.
Total solids at 180 deg. Cent.	15 (approx.)
Chlorine in chlorides	2·2
Nitrogen in nitrates	0·0
Nitrites or free chlorine	Absent
Hardness—	
Permanent	—
Temporary	6
Total	6
Lead, copper, zinc, iron—Iron	0·002
Free ammonia	0·0010
Albuminoid ammonia	0·0004
Oxygen absorbed in 3 h. at 37 deg. Cent.	0·0000
Number of bacteria per cc.—	
On gelatine in 3 days	134
On agar in 24 h.	1
The *Bacillus coli*	Absent in 100 cc.
The *Bacillus enteritidis sporogenes*	Absent in 100 cc.

The mechanical filters, of which there are five, are of the Candy Filter Company's iron-eliminating standard steel-cased type, and they operate most successfully without any coagulant. The filtrate is quite colourless and there is no sign whatever in the filtered water of any iron, while none is precipitated after the water has stood for many days. All the five filters are worked in parallel together, and they are operated under a head of 30 lb. per square inch. Each filter has a filtering area of 53 square feet, and, since there are five filters dealing with a total of some 34,000 gallons per hour, each filter deals with 6800 gallons per hour, or at the rate of 128 gallons per square foot per hour. There are gauges to indicate the difference in pressure above and below the filtering material, and when the difference has reached 5 lb. per square inch the filtering material is washed in the ordinary way, first by agitating the sand by compressed air and then by reversing the flow of water. The compressed air is furnished at 10 lb. per square inch by a small compressor of the rolling drum type direct driven by a Pelton wheel actuated from the water main, which, it may be explained, works ordinarily under a head of between 400ft. and 430ft., though the main pumps, it will be remembered, were guaranteed to work against a head of 512ft. The tops of the filters are kept charged with compressed air at 30 lb. per square inch by a small single-stage compressor of the axial type, driven from the end of the pump shaft by a sprocket wheel and chain. We may say, in passing, that air for starting the main engines is also provided by a similar Pelton wheel belt-driven compressor, the pressure being 300 lb. per square inch. This compressor has its own air receiver. The wash water from the filters is discharged into a reinforced concrete tank outside the building, where the arrested solids gradually settle and the supernatant fluid, which has become quite clear, is allowed to flow back to the aerating and collecting reservoir, and the deposit is taken out and buried. We were informed that on an average each of the filters is washed twice a week. An interesting feature of the aeration and filtration is the fact that, as will be seen in the analysis of the treated water, it eliminates the temporary hardness.

We have received from Ruston and Hornsby, Ltd., a copy of the official tests of the two sets of engines and pumps, which were carried out on September 21st and 22nd last, the trials of each set lasting six hours. The figures obtained are given in Table III. The fuel employed was crude oil with a specific gravity of 0·934 and a calorific value of 19,000 B.Th.U. gross and 17,900 B.Th.U. net, approximately. It may be explained that the "Lonovane" and "Plurovane"

pumps were each 6in. machines, while the "Medivane" pumps were 5in.

TABLE III.—*Particulars of Tests.*

	Set No. I.	Set No. II.
Engine speed, r.p.m.	300	301
Pump speed, r.p.m.	1,274·3	1,275
Total gallons pumped	210,800	209,000
Gallons per hour	35,153	34,833
Gallons per minute	585·5	580·5
Head on Lonovane pump, feet	25·9	22·3
Head on Plurovane pump, feet	428·0	410·6
Head on Medivane pump, feet	87·0	89·3
Equivalent thousands of gallons per 100ft.	1,140·2	1,091·4
Weight of fuel used per hour, lb.	60·5	65·25
Water horse-power	95·9	91·9
Indicated horse-power	205·3	184·2
Brake horse-power	164·3	147·4
Fuel used—		
Per W.H.P. hour, lb.	0·725	0·71
Per I.H.P. hour, lb.	0·338	0·354
Per B.H.P. hour, lb.	0·424	0·443
Per 1000 gallons per 100 ft.-lb.	0·366	0·358
Efficiency of pumps and belt, $\frac{W.H.P.}{B.H.P.}$ per cent.	58·3	62·3
Overall efficiency of engines, pumps and belt, $\frac{W.H.P.}{I.H.P.}$ per cent.	46·71	49·8
Thermal efficiency, per cent.	19·65	20·0
B.Th.U. per P.H.P.	12,977·5	12,709·0

After the plant had been in operation for some time, Mr. Martin set himself to investigate the question of lubrication, as he believed he saw his way to effect considerable economies in the consumption of lubricating oil.

He carried out numerous experiments and tried various types of filters, both made by himself and purchased, with only partial success. Latterly, however, he has installed on each of his engines a patented oil filter, which is operating most satisfactorily. This filter, though quite small and taking up but little space, is, as a fact, capable of filtering just double the quantity of oil necessary for lubricating one engine. What he is doing now, therefore, is gradually to filter all the oil which had been used in his engines and saved prior to the installation of the filter, and is accumulating a stock of filtered oil, which is very nearly as clear as unused oil. Its flashpoint is a little below standard, but the viscosity remains standard. The filtered oil is free from moisture, sludge and impurities, and is suitable for further continued use. Moreover, he is obtaining, as the result of cleaning the filter, a substance which is very largely pure carbon, and which he has prospects of being able to sell at a remunerative figure. The dirty oil is forced by a pump of minute dimensions, which is driven off the engine, through the filter into a tank fixed on the wall of the engine-house at a sufficient height to command by gravity all points where lubricating oil is required throughout the plant.

In completion of this description of what is a thoroughly interesting water treating and pumping station, we may say that the volume of water pumped is recorded by means of a Venturi meter, and that the water level in the collecting and aerating reservoir is also recorded by a level recorder, so that it is possible to know at all times the conditions in which plant is opreating. In this connection it may be mentioned that the capacity of the pumps installed is slightly in excess of the natural flow of the well, with the result that the level in the latter falls gradually as pumping proceeds. In general, pumping is started at 6 a.m. and proceeds until 3 p.m., a period of nine hours, during which time the level is lowered by about 2ft.

Included in this scheme was the laying of 7 miles of 12in. pumping main and 4 miles of 9in. service main, the building of a foreman's house and two workmen's cottages.

In conclusion, we desire to express our best thanks to Mr. Martin for his courtesy in granting us facilities for visiting and making a thorough inspection of the pumping station, and for the help he has afforded us in the preparation of this article. Our thanks are also due to Ruston and Hornsby, Ltd., for the assistance they have rendered to us.

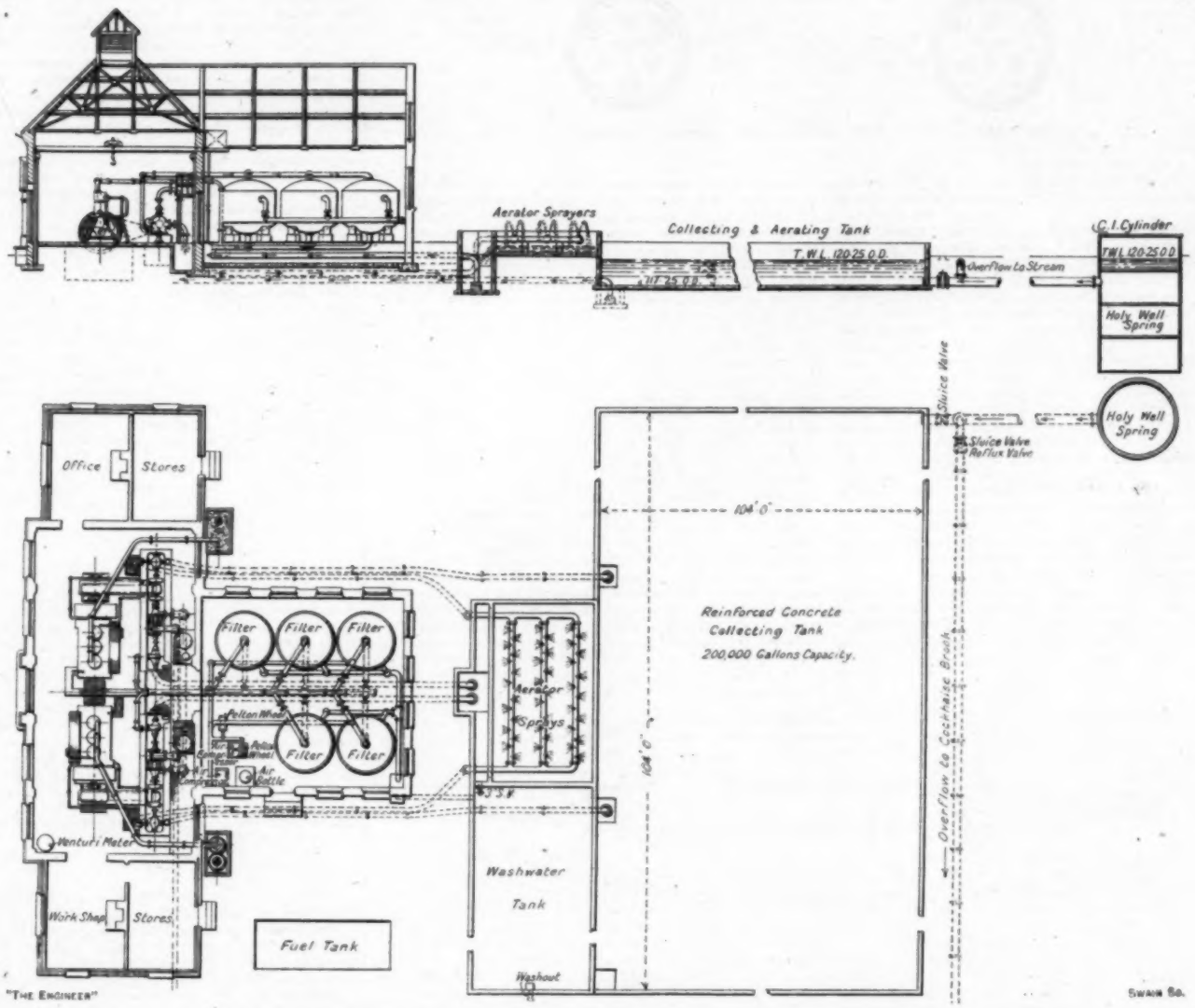


FIG. 2—ARRANGEMENT OF HORSTED KEYNES WATER TREATMENT AND PUMPING STATION

33,000-Volt Three-Core Cables.

SOME important claims for the S.L. type of three-core cable in which each core is separately lead-covered were made by Mr. Percy Dunsheath in a paper, entitled "33,000-Volt Cables with Metal-sheathed Cores, with special reference to the S.L. Type," read before the Institution of Electrical Engineers on Thursday, December 20th. During the past few years, the author remarked, it had become increasingly evident that the use of three-core cables for voltage higher than about 22,000 had introduced new and uncertain factors into the field of underground electric transmission. It was common knowledge that 33,000-volt cables had caused a good deal of anxiety to cable manufacturers and cable users, and the failures which had occurred had involved both sides in financial loss, besides introducing too frequent interference with the continuity of supply on large systems.

The outstanding feature of the breakdowns was the long period which elapsed after the cables had been brought into use before failure occurred. It was no uncommon experience for the individual drum lengths to be subjected to stringent factory tests of, say, 75,000 volts three-phase for 15 minutes, for the complete jointed section to be pressure tested with, say 90,000 volts direct-current, by valve or mechanical rectifier for 5 minutes, and then, after all that, for the cable to fail in service at 33,000 volts after a year or two's satisfactory working. An interesting fact also noted by several observers was that the majority of the failures occurred during times of light load on the cables.

Various explanations had been advanced to account for this new type of failure, but the most probable one to-day seemed to be closely associated, though not identical, with that which was first advanced by Hockstädter and supported by more recent investigators. Hochstädter attributed the failure to tangential electrical stresses in the outer layers of the core dielectric. It was well known that impregnated paper had a higher electric strength in a direction perpendicular to the surface than along the surface, and that would seem to justify the tangential-stress theory. In the light of modern experience, however, that theory was not quite sufficient to explain what occurred. It was a common experience, for instance, in examining a piece of cable which had failed under the conditions stated, to find a large proportion of the length still in perfect condition, with no sign of deterioration, although the tangential stresses, on the theory named, were the same throughout.

If the tangential-stress theory were supplemented by considerations of the ionisation of air or other gas in a space within the dielectric under stress, then we approached more nearly to an explanation which would cover the recorded phenomena. In other words, if the dielectric were subjected to tangential stresses at a point where the space which should be filled by oil contained air instead, then an electrical discharge might occur over the surface of the paper which would result in the slow destruction of the paper fibres and ultimate total failure of the cable.

The presence of spaces devoid of insulating compound between the cores of a three-core cable could be summarised as follows:—(1) Faulty mechanical construction; (2) imperfect impregnation; (3) distortion and separation of the cores by mechanical stresses during laying; (4) separation of the cores by thermal expansion during heating under load.

Dealing with suggested improvements on plain three-core cable, the author said that several suggestions had been made for the design of a three-core cable in which this destructive action could be prevented. In 1914

Hochstädter took out a patent entitled "Improvements in Electrical Conductors," for covering the individual cores with a tightly adhering conducting film so as to level up the distribution of potential in the direction of the layers. At a later date the same inventor protected the manufacture of a perforated metallised paper for use as the conducting film, and many cables had been made in which the impregnation had been carried out after the application of that type of coating.

Generally speaking, that construction was the one usually referred to in Europe as the Hochstädter cable, although in the United States, owing apparently to a different interpretation of the patent situation, Hochstädter cables had been made with a covering over the individual cores consisting simply of a thin copper tape applied with a narrow gap between turns.

In 1917 P. H. Chase obtained protection for a cable in which the cores were lapped with a thin metallic tape slit at frequent intervals in such a direction as to restrict eddy currents, and yet permit of the flow of heat from the centre of the cable outwards. Those slits also obviously permitted of impregnation after lapping and laying up. Cables had recently been manufactured to that design in the United States.

About two years ago another design appeared to achieve the fundamental object of the core sheath. In that case, instead of the surface of the cores being metallised, a metal coating was applied to the surface of the wormings and centre packing before assembly. Still another method

FIGS. 1 AND 2—"S L" TYPE EXTRA HIGH TENSION CABLES

adopted to prevent tangential stresses was the filling of the worming spaces with conducting material in the form of powder.

In considering the advantages of metal-sheathed core cables, the author remarked that in comparing the relative merits of plain three-core cables and those with metal-sheathed cores for use on a working pressure of 33,000 volts, it had to be admitted that, as regards reliability in operation, the metal-sheathed type had many advantages and practically no disadvantages. The advantages were summarised as follows :—(1) The long-time failures experienced on plain three-core cables had been found to originate in core-to-core faults, and not between core and earth. The metal-sheathed core cable had a larger core-to-core thickness for a given diameter of cable than the plain three-core type. (2) The presence of the metal sheath prevented direct core-to-core faults, and in case of failure from any cause the breakdown took place to earth, which was an advantage from the operation point of view. The fault current could be limited by earth resistance in the neutral. (3) The electric stress was uniformly radial in all parts of the dielectric and consequently normal to the surface of the paper. (4) The whole of the dielectric subjected to stress was homogeneous. There were no wormings or packings in the electric field. (5) Separation of the cores by mechanical distortion of the cable, or by thermal expansion, could not introduce voids into the dielectric under stress. Should the cores become separated from one another by a small fraction of an inch from any cause whatever, the conducting sheath moved with the core, and the space that was formed was outside the field and out of contact with the dielectric. (6) The metal sheaths facilitated the carrying of the heat away from the centre of the cable, which was the hottest and therefore the most dangerous part.

The only practical disadvantage that could be advanced against the metal-sheathed core cable was that it had a slightly higher inductive capacity than the plain three-core type. On modern systems, however, that was not a serious point, as the charging current on no-load helped to neutralise the magnetising current of large connected transformers, and on load the leading current was soon lost in connected plant with lagging power factor.

TWO CLASSES OF SHEATHED-CORE CABLES—S.L. AND NON-S.L.

The various types of metal-sheathed core cables described could, the author explained, be divided into the two classes :—(*a*) Cables with a common lead sheath over the assembled cores which were laid up before the impregnation process was carried out. (*b*) Cables in which the individual cores were dried, impregnated and lead-covered before being laid up, that type having no enclosing lead sheath over the assembled cores.

The claims of the second type of cable—the separately lead-covered cables—referred to for convenience as the S.L. type, for use on 33,000-volt systems, were first advanced by the author in a discussion before the Institution three years ago, and since that date he had carried out extensive experiments to resolve certain questions of supreme importance in deciding on the suitability of this type for general use.

Figs. 1 and 2 showed, he said, two designs of S.L. cable. In the former, three separately lead-covered cores were laid up, together with packings to a circular formation for taking the two coats of steel-tape armour with beddings and servings. In order to give the cable longitudinal strength while retaining the maximum flexibility, three steel reinforcing strands were laid up in the spaces between the cores, as shown. In the second design, shown in Fig. 2, advantage had been taken of the opportunity which that construction afforded of housing pilot cores under the one common armouring with the main cores and inside the reinforcing strands. Another feature of importance—also illustrated in the first figure—was the employment of a tight whipping of copper tape over the core papers immediately under the lead, which provided mechanical support to the papers, strengthening the cores and keeping them circular without depending on any restraining effect of the lead tube.

Briefly, Mr. Dunsheath remarked, the relative merits of S.L. and non-S.L. metal-sheathed core cables could be studied by stating the advantages and disadvantages of the first over those of the second :—(1) In the S.L. type large-diameter lead tubes were avoided. In view of the plastic nature of lead and the necessity for bending, that resulted in a better mechanical construction. For a given overall diameter of cable, a given amount of bending resulted in less distortion of the lead sheaths in the S.L. type than in the other forms of metal-sheathed core cables. (2) Owing to the greater mass of metal surrounding the individual cores, the cooling effect and consequently the current-carrying capacity was greater for the S.L. type than for the others. (3) For use in hilly country, where there might be a considerable head of oil in the cable, the S.L. type with its small-diameter lead sheaths and absence of worming spaces filled with oil, had obvious advantages. The whole of the oil inside the lead sheath of the S.L. type of cable, being in contact with the laminated dielectric, was less liable to flow than when it was not so supported, as in the non-S.L. type. (4) The adoption of the S.L. type made possible the use of longitudinal steel reinforcing strands or pilot cables in the scores between the cores and outside the dielectric. (5) The S.L. type of cable permitted of freer impregnation. Each core was impregnated separately instead of all three cores with their wormings being treated together as in the non-S.L. type.

A disadvantage advanced against the S.L. type of cable, was, the author said, the presence of undesirable currents in the lead sheaths, owing to their enclosing the separate conductors and being cut by the rotating magnetic flux. The sheaths might be insulated from one another, in which case it was sometimes stated that dangerous voltages might exist between them, resulting in sparking across and pitting of the lead. If they were bonded together, the circulating currents caused loss of energy and by their heating effect reduced the current-carrying capacity of the cable. It could be shown, however, that the voltages generated were very small, that they could be suppressed by bonding the three sheaths together at the ends, that when the sheaths were bonded in that way the sheath losses were negligible, and that the presence of the separate sheaths, instead of increasing the temperature rise and cutting down the current-carrying capacity of the cable, had the opposite effect to a very marked extent.

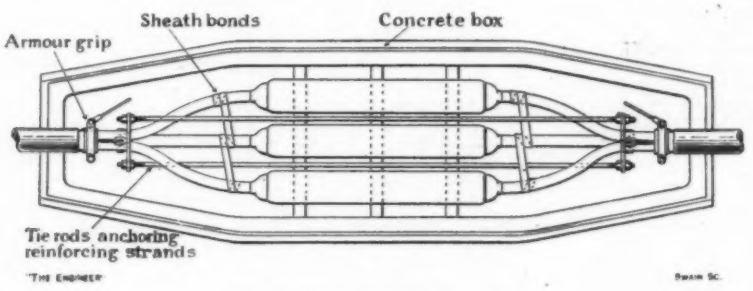


FIG. 3—JOINT IN "S L" CABLE

In dealing with the jointing of S.L. cables, Mr. Dunsheath said that, as each core was in itself electrically complete, the electrical joint in the complete cable consisted of three simple single-core joints. The most convenient method of arranging them was side by side, as shown in Fig. 3, which illustrated the jointing for a tape-armoured S.L. cable having reinforcing strands. Three separate lead-sleeve joints were carried on porcelain bridges in a concrete container, which was afterwards filled with a pitch compound. Provision was made for rigidly anchoring the reinforcing strands from one side to the other and for bonding the lead sheath and armouring together. A termination on an S.L. cable was a simple matter, as the separate cores were carried away to single terminal insulators, the armouring being terminated separately on a suitable fitting.

In summing up, the author said that metal-sheathed core cables had many important advantages over plain three-core cables, and practically no disadvantages. Of the two types of metal-sheathed core cables, the S.L. type had important advantages over the non-S.L. type, but it had been considered to have disadvantages because of the voltage generated and losses incurred in the sheaths surrounding the separate cores. A wide range of tests had, however, shown conclusively that those fears were groundless. The voltages were very small, even when not suppressed by bonding, and when the cables were bonded together the losses due to eddy currents were negligible. Moreover, contrary to the previous supposition, that the losses reduced the rating of the cable by the heat generated in the sheaths, the cooling effect of the sheaths carried the balance far in the opposite direction, resulting in the S.L. type of cable running very much cooler than the plain three-core cable. Considering also that the S.L. cable was lighter than the plain three-core cable, and carried with its use a very simple joint construction, in addition to the known electrical advantages, it seemed that an unanswerable case was made for its use as a solution of the 33,000-volt cable problem.

Books of Reference.

"BRITISH Rainfall, 1925."—"British Rainfall," which is published by H.M. Stationery Office and can be obtained through any bookseller, price 15s. net (postage 5½d.), is now issued under the auspices of the Air Ministry. The present volume is a summary of the rainfall observations made during 1925 by some 5000 observers throughout the country, collected and collated by the British Rainfall Organisation, Meterological Office. It is the sixty-fifth volume of the series, and is arranged on the same lines as the earlier volumes. It includes maps, tables and text dealing with the distribution of the rainfall in each month and for the whole year, both in inches of rainfall and as a percentage of the average fall; the distribution of heavy falls of rain in short periods; the number of days with rain during each month and the year as a whole, and the sequence of spells of dry and wet weather in various parts of the country. Sections are devoted to the duration of rainfall recorded by autographic gauges, and to records of evaporation and of percolation through the soil. Statistics of the annual amount of rainfall and of the number of days of rain are set out for 4886 stations. Three articles on various branches of recent rainfall research are also included in the volume.

"THE Colliery Manager's Pocket-book, Almanac and Diary for the Year 1927." Published by the *Colliery Guardian* Company, Ltd., 30 and 31, Furnival-street, Holborn, London, E.C. 4. Price 3s.—With this year's issue this useful book of reference reaches its fifty-eighth year of publication, and is so well known that it requires no introduction from us. All that need be said is that the volume appears to have been carefully gone through, so as to bring it thoroughly up to date. The sections on "Coal and its By-products," "Valuation," "Mine Ventilation," "Rescue and Ambulance," "Explosives," "Electricity in Mines," and "The Strength of Materials" have been revised, while in the section dealing with machinery, the matter relating to "Engines and Boilers" and "Winding and Haulage" have, we are informed, been rewritten by acknowledged experts.

"THE *Mechanical World* Year Book, 1927." Published by Emmott and Co., Ltd., *Mechanical World* Office, 65, King-street, Manchester, and 20, Bedford-street, London, W.C. 2. Price 1s. 6d. net.—This book, which we have many times found useful, is now in its fortieth year of publication. We learn from its preface that in this year's issue, while some new sections have been added, some of the permanent sections have been re-written or revised There is a long section on "Rails and Wheels" and another dealing with "Belt Conveyors." The section on "Toothed Gearing" has been re-written, as has also the matter relating to "Condensing Plant for Steam Turbines." New material regarding "Air Pumps" has been included, and also a table of dimensions of vertical boilers. Various revisions have been made in the matter on "Structural Steelwork," while tables of "Cutting Speeds," "Extra Heavy Steam Piping," &c., are included.

"ICE and Cold Storage Trades' Directory, 1927." Published by Iliffe and Sons, Ltd., Dorset House, Tudor-street, London, E.C. 4. Price 10s. 6d., or 11s. post free.—This is the twenty-second issue of this annual directory, which is intended to serve the many and varied interests connected with the cold storage, ice-making and refrigerating industries. We understand that it has been carefully revised and brought up to date, and that it includes several hundred additional names in the alphabetical and classified trades sections. The increasing application of refrigeration in nearly every branch of trade has necessitated the inclusion of several more headings in the classified trades section. As usual, the front portion of the book is devoted to tables which contain information which is not readily obtainable in so compact a form elsewhere, and later, details are given of new companies, registered since the last issue, the articles of association of which include refrigeration.

THE iron ore mined in the United States in 1926, exclusive of ore that contained 5 per cent. or more of manganese in the natural state, is estimated at 67,693,000 gross tons, an increase of 9 per cent., as compared with that mined in 1925. The ore shipped from the mines in 1926 is estimated at 69,141,000 gross tons, valued at 175,307,000 dollars, an increase of 8 per cent. in quantity and of 9 per cent. in total value, as compared with the figures for 1925. The average value of the ore per gross ton at the mines in 1926 is estimated at 2·54 dollars; in 1925 it was 2·52 dollars. The stocks of iron ore at the mines, mainly in Michigan and Minnesota, apparently decreased from 10,795,630 gross tons in 1925 to 9,496,000 tons in 1926, or 12 per cent. About 85 per cent. of the iron ore shipped in 1926 came from the Lake Superior district.

Railway Matters.

THE first sod of the Australian north-south transcontinental extension from Oodnadatta to Alice Springs was turned last Friday.

THE automatic train control system used on the Great Western Railway requires the battery on the engine to be in service even when the locomotive is at rest. An automatic vacuum-operated switch is now being tried on six engines which automatically cuts off the battery when the engine is not under steam.

THE London, Midland and Scottish Company has now in service 235 all-steel passenger coaches similar to those described in THE ENGINEER of April 23rd last. Some 473 new engines will be built during the present year, of which fifty will be express passenger engines and eighty-seven for mixed traffic, *i.e.*, for fast goods or for excursion trains.

IN connection with the one-way traffic through Piccadilly-circus it is stated by the Works Committee of the Westminster City Council that the enlarged station there of the London Electric Railways will not be completed before the beginning of next year, and therefore the contractors' shafts cannot be removed for another twelve months.

THE Great Northern Railway (of America) adopted automatic signalling in 1907, and not only has the whole of its 1794 miles between St. Paul and the Pacific coast been equipped throughout, but its total of 2998½ miles is, except the Southern Pacific, the largest in the United States—and therefore in the world. It is instructive to note that since the first installation was made not a single passenger or servant has been killed or injured in a collision on an automatically-signalled section.

As the morning express from Manchester to York was proceeding over the Charlestown curve on the former Lancashire and Yorkshire Railway on Thursday of last week the leading wheels of the tender left the rails. There were no personal injuries and but little material damage. The accident is noteworthy mainly because of the fatal derailment near the same spot on June 21st, 1912, when four passengers were killed. In that case there was an undoubted excessive and unsuitable speed over the curve, and the late Colonel Druitt criticised the employment of tank engines of the heavy type used at so high a speed over such a curve.

A POINT made in the report of the London and Home Counties Advisory Committee's report on transit accommodation in East London was that the London County Council proceeded with its housing scheme on the Becontree estate irrespective of the railway facilities. The Ilford Council has now written to the Ministry of Health, Ministry of Transport and the London County Council as to the proposed erection of a further 2137 houses, and suggesting that the work be postponed or "the existing deplorable conditions [of railway travel] will be further aggravated, inasmuch as the additional passengers who will enter the trains at the stations immediately east of this [the Ilford] district would further reduce the already inadequate accommodation now provided for passengers travelling to and from London."

THE line from Point Pleasant Junction, Wandsworth, to East Putney Station, on the London and South-Western section of the Southern Railway, is not only on a steeply rising gradient, but the further end, where East Putney Station is entered, is on a sharp curve. Under adverse weather conditions long empty carriage trains, on their way from Waterloo to be stabled at Wimbledon, frequently get stalled. Such a thing happened on Monday morning last, and a light engine had to be sent to "bank" the train. It is said that the assistant engine "fouled the points and left the line." Presumably that would be at the trailing points of the junction for the Putney Bridge line. The electric trains of the Southern and the Metropolitan District over the Wimbledon section were suspended for two hours. On the same morning there was a rather bad buffer stop collision in one of the bay lines at Moorgate, Metropolitan Railway, in which one of that company's electrically operated trains was involved.

ON the morning of September 18th last a light engine arrived at Wortley East Junction box, near Leeds, London and North-Eastern Railway, in order to enter Copley Hill engine shed. To do that the engine had to pass the box and then set back. Just ahead of the box is a junction on to a loop, and the signalman set the points for the engine to enter upon that road, and it was his intention that it should wait there for a few minutes until a passenger train had passed. When the signalman thought the engine was in the loop—a fact of which he could not be certain owing to a ground mist—he closed the points and signalled the passenger train. The engine was not, however, clear, and a collision resulted. Major Hall inquired into the accident, and in his recently issued report thereon he does not blame the driver, but recommends that the disc signal for setting back into the engine shed be replaced by a disc on the loop further from the box, and a corresponding signal on the main line. That will ensure that engines will run forward clear of the junction into the loop.

ACCORDING to the Board of Trade returns, the value of the railway material exported during the first eleven months of last year was as follows, the corresponding figures for 1925 and 1924 being added in brackets:—Locomotives, £2,921,060 (£2,348,430, £1,729,801); rails, £1,331,633 (£1,711,502, £1,493,066); carriages, £2,538,142 (£1,444,433, £1,080,787); wagons, £2,638,990 (£3,283,487, £3,074,608); wheels and axles, £405,937 (£548,249, £537,620); tires and axles, £272,492 (£413,207, £566,649); chairs and metal sleepers, £636,558 (£942,103, £1,106,587); miscellaneous permanent way, £1,026,973 (£1,319,878, £1,044,974); total permanent way, £3,838,292 (£5,121,178, £4,959,985). The weight of the rails exported was 163,665 tons (185,219 tons, 160,758 tons), and of the chairs and metal sleepers, 65,451 tons (85,795 tons, 88,195 tons). During the month of November last locomotives to the value of £88,243 were sent overseas, and they included:—South Africa, £38,033; the Argentine, £23,309; and India, £14,800. The rails shipped in the same month were of the value of £14,259, and included:—India, £2459; Australia, £1614; and New Zealand, £1219.

Notes and Memoranda.

FOR several years it has been felt, says the Standard Oil *Bulletin*, that the petroleum reserves of America lie not entirely in the discovery of new fields of oil, but also in the finding of new supplies below existing fields through deeper drilling. As things have progressed, particularly in the perfection of drilling apparatus making it possible to penetrate the earth to depths which seemed impossible only a few years ago, this theory is being proved. In a number of fields throughout the country new supplies of oil have been found under old fields.

A CAREFUL comparison of the statistics of boiler failures proves, according to *Vulcan*, that, having regard to the number of boilers and steam apparatus employed, Great Britain enjoys a greater immunity from danger in their working under its present system of insurance and inspection than any other country in the world. This happy result is no doubt due to the almost universal adoption of boiler insurance and the highly efficient system of periodical examinations carried out by the expert engineers of the companies by which the great bulk of the work in this country is done.

AN exhibition will be held at Como from May to October next to celebrate the hundredth anniversary of the death of Alessandro Volta. The exhibition will include an International Exhibition of Electric Communications, an Exhibition of Italian Hydro-electric Industries, an Italian Silk Exhibition, an Art Exhibition, and various temporary exhibitions. The management of the Exhibition is entrusted to an executive committee assisted by special advisory committees. Further information in regard to the arrangements for the exhibition may be obtained from the secretary, Comitato Esposizione, Villa Olmo, Como.

WHAT is said to be the most extensive reinforced concrete bridge yet constructed has, according to the *Contract Record*, recently been completed across the Minnesota River between Fort Snelling and Mendota, Minn. There are in this structure thirteen open-spandrel, two-rib arches of a clear span of 283ft. 4in. The total length of the structure, including shore approaches, is 4119ft. Some 76,000 cubic yards of concrete were employed, the proportioning of which was in accordance with the basic principles of the water-cement ratio theory. Great speed was attained in construction through the use of three-hinged steel arch centres, an expedient made possible by the great amount of duplication on this bridge.

IN co-operation with the National Research Council, an investigation is being conducted by the American Bureau of Mines to determine the fundamental conditions under which accidental explosion of ammonium compounds, during manufacture or when stored in large quantities, might arise. Investigations to date show that ammonium nitrate is not combustible, but supports combustion of oxidisable materials. Detonation is not readily initiated by fire or heat, but can be initiated by a detonator and by various other explosives, and is aided by increased confinement. Ammonium nitrate is more sensitive to detonation, and the rate of detonation increased at higher temperatures. A study of disastrous explosions has led to the belief that impurities in combustible materials has had an important part in causing them. Future investigations will study the effect of impurities, especially easily combustible materials.

A RECENT publication of the United States Bureau of Standards deals with the testing of sixty-nine columns, having H-shaped sections, of five different types of construction—(1) light and (2) heavy fabricated plate and angle sections, (3) light fabricated channel sections, and (4) light and (5) heavy solid rolled sections—as flat end columns in the 10,000,000 lb. testing machine of the Bureau of Standards. The cross-sectional areas were approximately 35 square inches for the light and 85 square inches for the heavy sections. The lengths were 12ft., 18ft., and 24ft. Physical tests and chemical analyses were made on specimens cut from the columns and the results compared with the results of the column tests. No differences in the column strength definitely attributable to the differences in type of construction were found, but the pick-up of load observed showed marked differences due to differences in construction.

IN the course of a general study of liquid oxygen explosives, the United States Bureau of Mines is investigating the effect of physical and chemical properties of combustible absorbent materials and wrappers on absorption and retention of oxygen, explosive properties and formation of carbon monoxide, and applying the results of this fundamental knowledge to blasting under mining conditions. Tests of a number of brands of fuse developed as a result of similar tests last year have resulted in a better understanding of the effect of low temperature on the burning rate of fuses and of the requirements of a fuse for use with liquid oxygen explosives. Co-operative work along development lines is being conducted with a manufacturer of fuses. The relation between oxygen content of the cartridge and explosive strength has been investigated and the effect of purity of oxygen on the explosive properties of liquid oxygen explosive cartridges has been determined.

AT the outbreak of war in 1914 Germany was, according to Mr. W. J. U. Woolcock, the only country producing ammonia synthetically—by the Haber-Bosch process. To-day the factories at Leuna and at Oppau are operating on a prodigious scale, and are being extended, and it is expected that the output of pure nitrogen will exceed 450,000 tons annually. In Great Britain the synthetic ammonia and nitrates plant at Billingham, which is also based upon the Haber principle, is now in regular operation, and it is estimated that its capacity will eventually be 300,000 tons of ammonium sulphate per annum, or slightly less than the present total British output of by-product sulphate. America has seven important plants working, with a combined output of 70 tons of anhydrous ammonia per day—equivalent to 250 tons of sulphate—which, it is expected, will be increased to 100 tons per day by the end of the year. In Switzerland the Ammonia Casale Company, with headquarters at Lugano, has a plant with a capacity of about 135 tons of anhydrous ammonia per day.

Miscellanea.

THE first of the three turbines in the big new power station at Calcutta was started up on December 22nd. The ultimate capacity of the plant is to be 150,000 kilowatts in units of 16,000 kilowatts each.

SUGAR millers and cane growers of Queensland have subscribed the capital necessary for the establishment of an industry for the manufacture of megass into building board and a wide variety of other products.

A COMPANY with a nominal capital of £30,000 has been formed to work an area of tin-bearing land near Gilmore, Queensland. The area has been tested and is reported to show an average value of 1·5 lb. of tin oxide per cubic yard. A plant with a capacity of 30,000 cubic yards a month is to be installed.

THE Liverpool Corporation has decided to install a second large generating set in the new Lister-Drive Electric Power Station. The new set, which is expected to be in commission by the autumn of this year, will bring the total of generating plant on the Liverpool system for industrial and domestic purposes to 170,000 horse-power.

BRICKLAYERS and stonemasons in Toronto have received an increase in wages of 1 dollar a day for a period commencing May 1st, 1927, and ending December 31st, 1928. The new rate is 1·25 dollars an hour for an eight-hour day. The union bricklayers, as a result of the agreement, receive the highest wage rate of local trade union members.

THE season's activities of the Canadian Vickers Company, Ltd., Montreal, in ship repairs, aggregated a total of 225,000 gross tons, while sixty-two lake and ocean vessels were handled in the company's dry dock, which has a capacity of 25,000 tons, is 600ft. long, and can be used as a whole as well as in two parts. Twenty vessels were repaired in the basin.

IT is reported in the *Chemical Trade Journal* that Lazote, Inc., is to enlarge its synthetic ammonia plant to about five times its present capacity. The foundation for the second unit is completed and work on the third unit will start this spring. It is also stated that the capital of the company will be increased from 5,000,000 to 10,000,000 dollars.

DURING the past year the number of consumers connected with the Tasmanian hydro-electric supply system increased by 6 per cent., making a total of 12,180 consumers. For the year 279,000,000 units of power were generated, being an increase of 87,000,000 on the current generated in 1923. During the year the total stoppages of current supply amounted to nine minutes only.

THE Great Indian Peninsular Railway has decided upon constructing an independent electric power station in connection with its scheme of electrifying the lines between Bombay and Igatpuri and Bombay and Poona. The site has been chosen at Kalyan. The cost of building and equipping the station is estimated at Rs. 100 lakhs, of which Rs. 90 lakhs will be spent on generating plant and transmission lines. The order for these will be placed in England through the High Commissioner for India.

ON account of a loss of £40,530 incurred during the twelve months ended June 30th last, the Australian Railways Commissioners decided to abolish the steam tramways at Parramatta, Maitland, Broken Hill, and Arncliffe to Bexley as from January 1st, 1927, and leave future transportation at these centres to private business enterprise. It costs the department, according to present figures, fourpence to carry each passenger who pays a twopenny fare on the lines. The Commissioners believe that the expense of electrifying the lines would not be justified.

AT the annual general meeting of the Associated Chambers of Commerce of India and Ceylon, held at Cawnpore in December, the following resolution, states the secretary, was unanimously adopted:—That in view of the increasing use of motor vehicles of all descriptions in this country for commercial, industrial and private purposes, this Association is of the opinion:—(1) That a Central Road Board should be created to advise upon and control a general road policy for the whole of India; (2) that the import duty on motor vehicles should be reduced as soon as possible; (3) that a special vehicle tax should be levied in all provinces where necessary, the proceeds of which should be devoted exclusively to the improvement, maintenance and construction of roads and bridges.

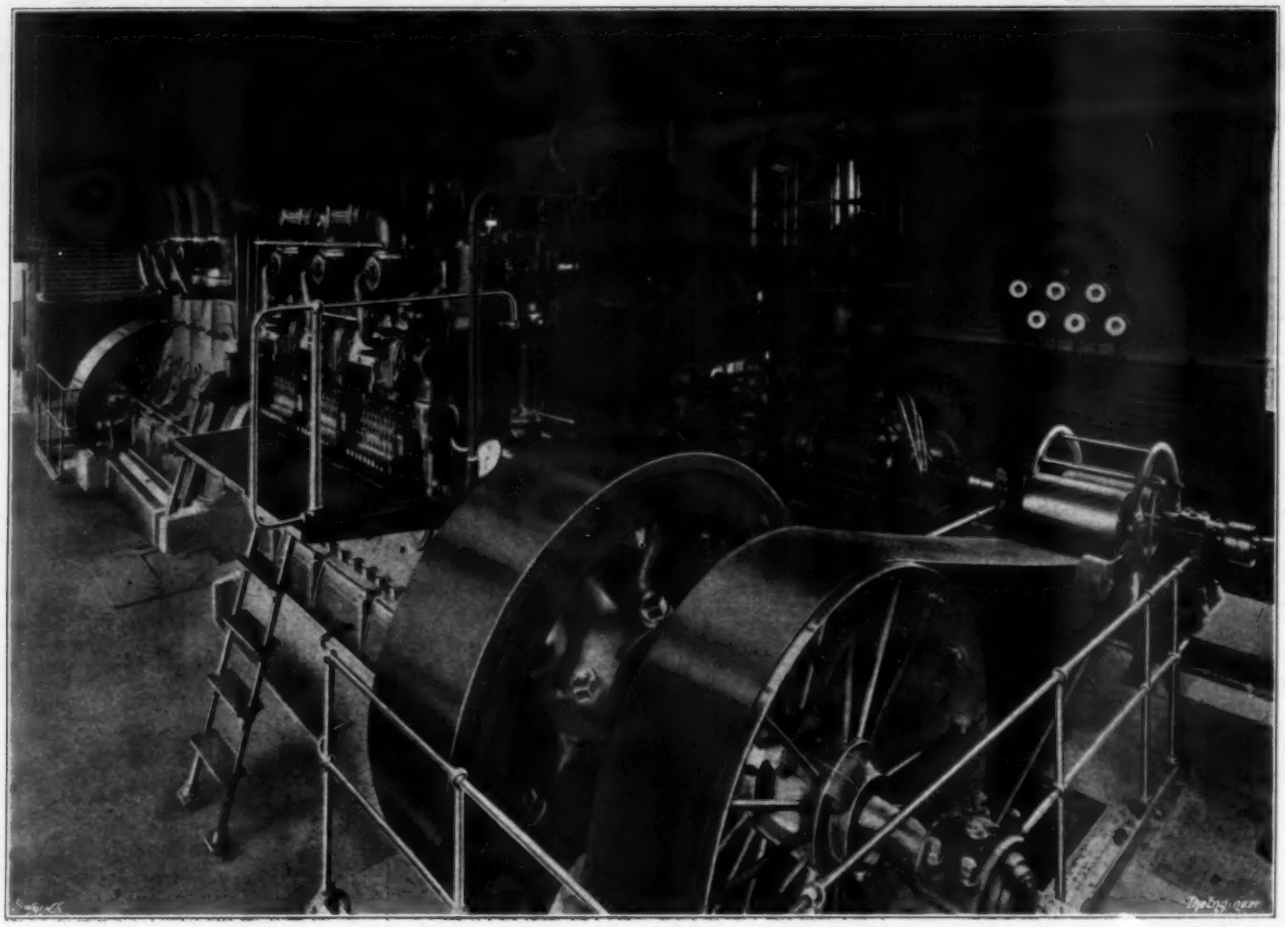
A SCHEME to increase the stocks of water in the Geelong, Victoria, district has, says the *Industrial Australian*, been outlined by Mr. Shaw, of the Victorian State Rivers and Water Supply Commission. The source of this, known as the Bellarine scheme, would be the Upper Barwon, in the Otway forest, where the yearly average rainfall was 60in. The water would be conveyed from the head works in an open concrete channel to Lake Wurd, Boluc, Modewarre and Moriac to a hill at Waurn Ponds, where it was proposed to construct a reservoir, from which the water could be sent to Montpellier to augment the Geelong supply, and to Belmont, Torquay, and Barwon Heads to Bryant's Hill, where another reservoir would be constructed, and from which a 220 lb. pressure would be available for Queencliff.

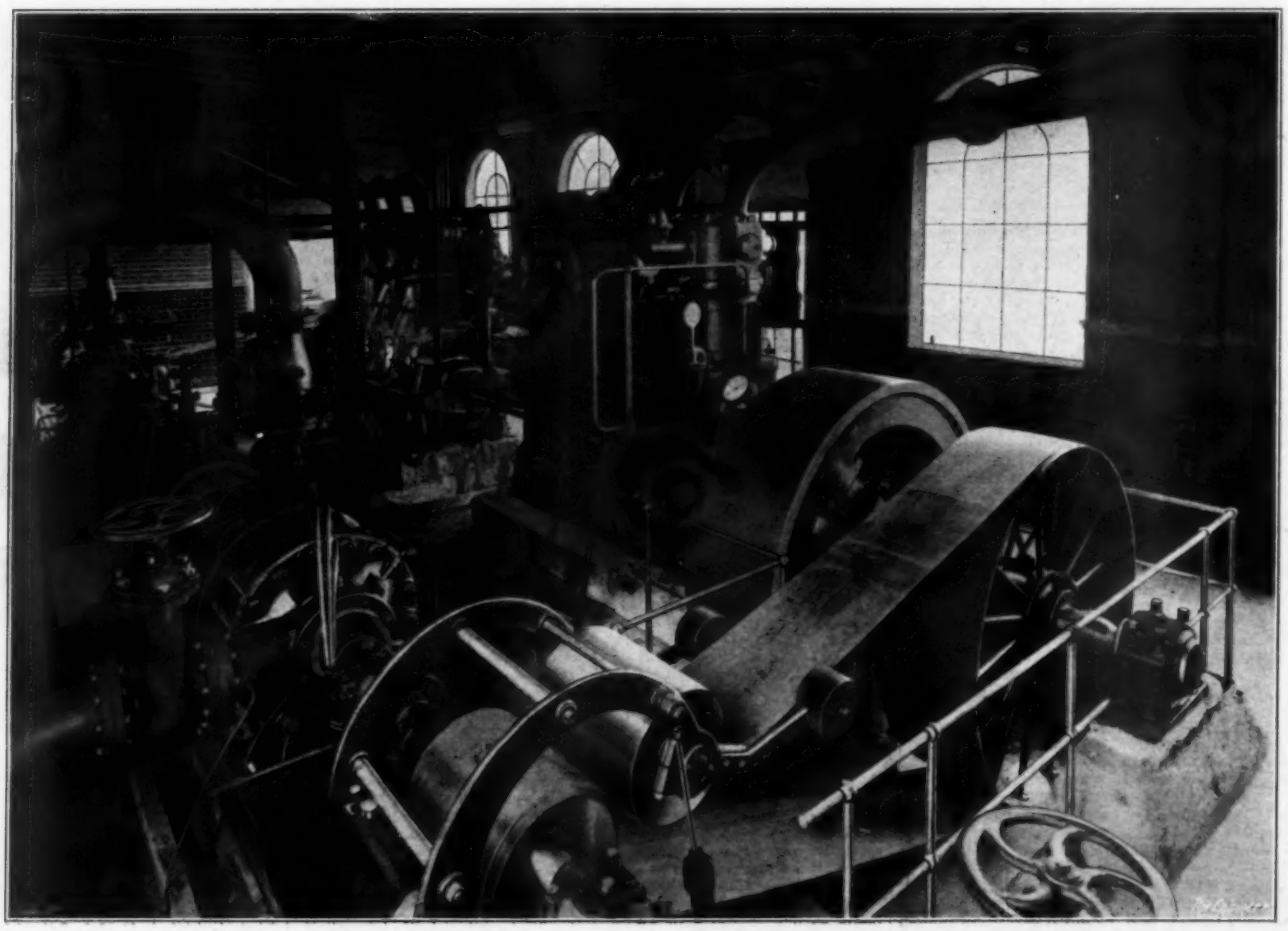
IT is reported from Milan that, with a view to improving transport between the North Sea and the Mediterranean, a concession has been applied for by the Hafraba Company, of Frankfort, to construct a motor road between Genoa, Milan and Hamburg. The engineering difficulties are said to be few. Forty-two per cent. of the distance, 830 kiloms., would traverse the Rhine Valley and 33 per cent. Northern Germany. The difference in levels would not exceed 300 m., and the highway, after passing Basle, would take in the Gothard Pass and touch at Zurich. If the Gothard route were obstructed by snow or otherwise closed, motor vehicles would be carried by rail from Goschenen or Airolo. The road would be 8 m. to 9 m. wide, and the bed of the road would be of cement or asphalt, or partly of both. The cost of this part of the work is estimated at 137,000 marks per kilometre. The entire construction with equipment is expected to cost at least 120,000,000 marks.

THE HORSTED KEYNES PUMPING STATION

MR. F. MARTIN, M.I. MECH. E., HAYWARDS HEATH, ENGINEER

(*For description see page 98*)





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SIXTEEN-PAGE SUPPLEMENT—"THE METALLURGIST."

The Metallurgist

THE JANUARY NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE ENGINEER.

JANUARY 28, 1927.

America and the Cruiser Question.

THE fact that the United States Naval Supply Bill for 1927–28, as passed by the Lower House of Congress on January 8th, makes no provision for new ships, constitutes a decided rebuff to the American naval agitators who have been so active of late. Barely a week before Christmas a Bill providing for the construction of ten cruisers was introduced to the House by Mr. Butler, Chairman of the Naval Affairs Committee, with the approval of President Coolidge. As this measure was intended to supplement the programme adopted in December, 1924, authorising eight new cruisers, its passage would have committed the United States to the building of no less than eighteen ships of the 10,000-ton class, or two more than the total proposed for the British Empire from 1924 to 1930 inclusive. That the President should have lent his patronage to a Bill of this character was the more surprising in view of his outspoken condemnation of competitive naval armaments last September, and of his refusal, early in December, to sanction the opening of credits for laying down the last three ships of the 1924 programme. His action was naturally construed as a *volte-face*. It came out in the course of debate that on the eve of the introduction of the new Bill the members of the Naval Affairs Committee had visited the White House to lay before the President "certain information which he did not before possess." What that information was has since been divulged by Mr. Butler, the Committee chairman. Briefly, it amounted to this—that all the Powers which signed the Washington Limitation Treaty, save only the United States itself, had systematically violated the spirit, if not the letter, of that treaty by continuing to build cruisers, submarines, &c. This extraordinary charge was afterwards elaborated by Mr. Butler, who told the American Press that the United States was "fooled out" of naval supremacy at the Washington Conference, that "a new high-speed naval race for primacy at sea has been started by foreign Powers," and that it behoved the United States to join in the "race," unless it was prepared to sink to third or fourth rank in the naval hierarchy. It has further been revealed that the data upon which Mr. Butler and his colleagues based their conclusions were supplied to them by the U.S. Navy Department.

This is not a matter that concerns the United States alone. The good faith of this country has been directly impugned in the American Legislature, and we therefore offer no apology for ventilating the subject. Before coming to details, let us broadly survey the world's naval construction since the war. Judging from Mr. Butler's statements, it might be inferred that the entire responsibility for such naval competition as there has been in the post-war period lies with Europe and Japan, and that the United States has been entirely blameless. Since that view appears to be held almost universally in the United States, it is desirable to state the facts. It is true that a very intensive ship-building competition was in progress for the first three years after the war, but it was confined entirely to the United States and Japan. Moreover, this competition was undoubtedly initiated by the United States, Japan being an unwilling participant in a race which she was financially incapable of sustaining. America was the first Power, and indeed the only Power, to embark on a great programme of naval construction immediately after the war. Between the Armistice and the Washington Conference, a period of exactly three years, she laid down sixteen capital ships and a swarm of other craft. Within the same period Great Britain began one submarine and authorised the construction of four capital ships. Clearly, therefore, the onus of reviving naval competition rests on the United States. As all the world knows, the Washington Conference put an end to battleship rivalry, this result being achieved at the cost of substantial sacrifices by most of the parties concerned. We cannot for one moment agree that America gave up more than Great Britain, and we are prepared, if necessary, to disprove that claim by unimpeachable facts. The Limitation Treaty fixed definite ratios of capital ship and aircraft carrier tonnage for the five signatory Powers; it did not restrict the number of cruisers or lighter craft, but merely imposed limits on the displacement and armament of such vessels. As these ratios and rules have been observed with scrupulous exactitude by all parties, there is not a shadow of justification for Mr. Butler's charge that the Treaty has been invalidated by non-observance. Nor can we discover any ground for his allegation that "a high-speed naval race" has been instituted. Since in this connection he lays special emphasis on cruisers, it is pertinent to review cruiser building activities since the Conference. Of such vessels, the British Empire since early in 1922—that is, in the space of five years—has built and authorised seventeen, which seems to us a very modest provision. In the same period Japan has begun eight cruisers, America five, France three, and Italy two. The total number of cruisers laid down in the post-Conference period by the five leading Powers is thus seen to be thirty-five, equivalent to seven ships a year. If that is Mr. Butler's notion of "a high-speed naval race," it is not ours. If America has omitted to make adequate provision for cruising ships, that is purely her own affair. She was entirely free to build as many of these vessels as she wished, and had she elected to keep pace with us nobody in this country would have raised a protest. It would appear, however, that the United States naval authorities hoped and expected that Great Britain would build no further cruisers after the Conference, in which event our establishment in this class would gradually have been reduced by the wastage due to age and deterioration until it reached the American level. In this way the non-capital strength of the two navies would have become equalised without the slightest effort on the part of the United States. No other inference is to be drawn from the published statements of Mr. Butler and his associates. What they have overlooked is the British Empire's peculiar need of an adequate force of cruising ships. It is an ironic circumstance that the strongest argument in favour of our current building programme is supplied in the letter which the Naval Affairs Committee, headed by Mr. Butler, addressed to President Coolidge last month. As quoted by the *Army and Navy Journal*, of Washington, that letter contained the following passage: "At the beginning of the World War there were about ten German raiders of various types at large. It took over 100 British vessels, operating for several months, to remove those raiders from the sea. Meanwhile they exercised a very injurious effect on British commerce, and on the steady and reliable flow of war material to the British Isles. These raiders were comparatively weak, unsupported by

bases in the theatre of operations, and unsupported by larger vessels of their own navy. You can readily visualise what a tremendous influence the numerous cruisers that might be opposed to us in war would have on our commerce." The writers proceed to argue that in view of this potential menace to her seaborne trade America should lose no time in building a sufficient number of cruisers. But if America needs cruisers to defend her commerce, our need of such vessels must be far greater, having regard to the immensity of our floating trade and our absolute dependence upon imported food and other commodities.

The truth of the matter is that we cannot afford to neglect our naval defences, even for the sake of pleasing our American friends. There is no real analogy between the naval requirements of the two countries, one of which is practically self-supporting, alike in peace and war, while the other could not exist for more than a few weeks without supplies from over the sea. At the same time this country would not take it amiss if America chose to expand her navy to the five-five ratio which the Washington Conference sought to establish, because America is not viewed as a prospective antagonist, and our own preparations for safeguarding our commerce bear no immediate relation to the strength of the American fleet. The only disturbing features of the present agitation in the United States are the baseless charges of bad faith brought against this country, and the obvious intention to discredit the Limitation Treaty. As regards the first, it can easily be demonstrated that no other signatory Power has observed its Treaty obligations more loyally than Great Britain. As for the second point, it seems to be forgotten that America was the prime mover in the campaign for naval restriction, that she organised and summoned the Washington Conference, and that the Treaty was drafted in the first instance by her own statesmen. It is to be hoped that history is not about to repeat itself in the sense that the Naval Treaty, like the League of Nations Covenant, is to be repudiated by its authors. In spite of certain palpable defects, the Treaty has proved beneficial to the Powers concerned. It has arrested the needless, expensive and dangerous rivalry in capital ships that set in soon after the peace, and it has relegated to the background the menace of war in the Pacific that had previously seemed imminent. No doubt these advantages are fully recognised by thoughtful people in the United States, and the fact that the new cruiser Bill has been temporarily shelved may be accepted as evidence that the naval extremists have failed to make any serious impression on public opinion.

Agricultural Engineering.

THE Show of agricultural implements and machinery held recently in the Palais des Expositions in Paris was one of the most instructive of its kind, indicating as it did changes in agricultural methods and trade conditions which must exert a decisive influence upon agricultural engineering. The first point to be observed is that competition for foreign trade, which is growing in all branches of industry, appears to have reached its culminating point in the manufacture and sale of agricultural implements and machinery. When war factories had to be turned on to peace work, the necessity of providing machinery for agriculture, which had to make up for four years of complete neglect, naturally opened up a wide vista to manufacturers, and, although many soon abandoned this branch of industry, the production of implements and machinery grew so rapidly that former markets for British agricultural engineering products were soon manufacturing all that they required for their own needs. The long period of currency depreciation gave a still further incentive to the development of a new national industry, which, so far as France is concerned, has become one of the most important. The same thing is observable in Poland, Czecho-Slovakia, and more especially in Germany, where the production is so considerable that it has been found necessary to organise the industry on an economical basis in order to be able to compete for foreign trade. The capacity of production of Krupp alone in harvesting and other machinery is enormous. There were exhibits of Krupp binders in Paris during the Show, although outside the precincts of the grounds. The French organisation is not the same, for each maker preserves his complete independence, but they are all members of the Chambre Syndicale des Constructeurs de Machines Agricoles, which exercises a powerful influence in protecting the interests of the home industry. What this means may be gathered from the fact that France was at one time by far the most important continental market for British agricultural machinery. That market has necessarily been lost by the disabilities of the exchange rate, and having now practically monopolised the home trade French makers will naturally do their best to eliminate foreign competition. When, therefore, it appeared that the relative stabilisation of the franc was bringing the prices of British machines in France to somewhere about the level of the French, it was surprising to find that this advantage had been suppressed by increases in the tariff coefficients which, at present, make it difficult to sell British goods in competition with the French. It is feared that the new Tariff Bill will put the duties still higher, or at least will make the importation of spare parts so far prohibitive that farmers will hesitate to purchase British machines. The future depends upon the attitude of farmers themselves, who are entirely opposed to the imposition of duties which may have the effect of increasing the prices of farm mechanism.

In these circumstances, it would appear that the outlook for the agricultural engineer, so far as his foreign markets are concerned, is very precarious. The situation, however, is not so bad as it seems. One of the reasons for the present economical trouble is the high cost of foodstuffs, which is due solely to insufficient production. If there were a surplus of grain and other produce, prices would come down, and bring with them a general decline in living costs. France is capable of growing everything she needs, and yet she has to import considerable quantities of grain to make up for a deficit. This is due solely to the fact that farmers are unable to put more land under cultivation because labour is too scarce, farm implements and machines are too dear, and the cost of producing grain and other produce is too high when the State takes preventive measures to keep down the selling prices of cereals. Therefore the whole problem lies in providing farmers with an ample supply of cheap machinery. This is one of the economic factors that may help to modify the new Tariff Bill, in the sense of facilitating the importation of machinery, for it is evident that if the French agricultural engineering industry is unduly protected it will be to the detriment of French agriculturists. As the agricultural industry the world over is limited by the labour supply, it does not follow that the deficiency can be made good entirely by machinery. The machine will not replace labour, and the more machines there are the more hands it will be necessary to employ. In France the problem is probably more complicated than it is elsewhere, and the French have long since come to the conclusion that the agricultural industry can only be developed intensively by making it a purely engineering industry. The farm labourer must be a mechanic, and every big estate must be managed by an engineer trained in the scientific and mechanical sides of agriculture. It was quite evident, from an inspection of what was presented at the Paris Show, that the agricultural industry is entering upon another stage of mechanical development. Until of late years, there were no changes in design, because manufacturers could not afford to modify designs that were turned out by mass production on a most elaborate scale, and the machines appeared, moreover, to be the most efficient and the most economical that could be devised. As regards cheapness and efficiency, there were probably few implements that could approach the binder. This compact arrangement of complicated motions with the aid of the cheapest devices is a model of ingenuity. In the manufacture of such machines labour has been eliminated as far as possible. The binder is one of the most labour-saving machines on the farm, and yet the Americans have gone still farther by exhibiting at the Paris Show harvester-thrashers, which cut the grain, thrash it and deliver it into sacks. Such machines were exhibited by the International Harvester Company—the Deering and McCormick—by the J. I. Case Thrashing Machine Company, and by the Massey Harris Company. They are all designed upon much the same lines. The grain, on being cut, is carried by the apron to the front of the thrasher, which is at right angles to the cutter bar, and is conveyed up to the beaters in the usual way. Thence the straw is ejected on to a platform at the rear and the grain is carried by a conveyor to shoots at the side of the machine, where it falls into sacks on another platform. Both platforms have tipping ends, so that the straw and the sacks of grain can be dumped on the ground as required. The whole machine is actuated by a four-cylinder petrol engine of 16 to 20 horse-power, which drives the cutter bar as well as the thrasher. The working of such a complicated mechanism built up with malleable iron gears, chains and iron castings, practically untouched by a tool, steel angles, and flats and sheet iron, cannot but evoke admiration at the way in which the agricultural engineer succeeds in evolving labour-saving machinery at the lowest possible cost. These harvester thrashers, with their 8ft. 6in. to 16ft. cutter bars, and weighing from 3 to 4 tons, are obviously only suitable for vast areas of cornlands, and for the moment they are destined more especially for North Africa, where grain is grown on a considerable scale. Under such conditions the economy is unquestioned. There is an economy in men and an economy in grain, which does not leave the machine until thrown off in sacks. There is no doubt about the suitability of this combined machine for the hard grain usually grown in hot countries, and it remains to be seen whether farmers would care to put into sacks immediately certain descriptions of wheat which they are accustomed to leave in the sheaves to harden. In any case, it does not appear as if the harvester thrasher will offer much scope on the smaller farms in France and in other parts of the Continent.

In view of the extraordinary development of the agricultural engineering industry on the Continent, it is obvious that it will not be possible to carry on business in foreign markets under quite the same conditions as in the past. The agricultural engineer of to-day has become a scientific organiser and an expert in economical production. It is hardly necessary to refer to the perfect organisation of the agricultural engineering industry in the United States, but less is known of what has been done in Germany, where the whole industry has been amalgamated and specialised down to the smallest detail, with a sales organisation which is spreading to all the markets of the world. On the other hand, there is a far larger field for business in agricultural machinery than ever before. Great as the production is, it will hardly suffice for the world's requirements when agricultural enterprise goes forth to develop the almost unlimited grain-bearing territories at present untouched. French makers are asking for protection to enable them to develop an export trade, because they know that at some time in the future the African Colonies will require enormous quantities of machinery which they want to be in a position to supply. Germany has always regarded Russia as a potential customer, which will eventually take most of the surplus machines she can produce. In view of this organisation, it might be supposed that the situation of British agricultural engineers, who rely upon an export trade, would be very precarious, but in reality the outlook is not so bad as it seems, for the British maker possesses certain advantages which should enable him to secure a fair share of the world's trade. The fact that he does not go in for mass production to the same extent as the American and the Germans leaves him with greater freedom to modify and improve his machines, for, however closely an agricultural machine may appear to have reached finality in design, it is always possible to do something a little better, and it is surprising to find how recognised mechanical methods can be replaced by something entirely different. No one could have thought of replacing the cream separator, which is the last word in finality, and yet at the Paris Show milk was pumped through a column of silex and the product was perfect butter. There is always an opening in foreign markets for new and improved machines, for the farmer is more alive to the value of economies than the manufacturer, and he is prepared to examine and test anything that may appear to offer possibilities. Sub-soil ploughs were first sent to Paris by British firms, who were also the first to introduce mole-draining machines, which, in view of the extraordinarily wet seasons of late years, are now recognised as necessary implements. Even in mowing and reaping machinery British firms are capable of holding their own against the great American and continental combines. Their machines have a reputation for quality which is unchallenged. That quality brings out certain advantages which the farmer appreciates. One British make of grass mower has always been specially favoured in Normandy because of its handiness for cutting grass in orchards. In the south-west of France no one would look at anything but a British steam portable until the monetary depreciation put up the price of such engines too far beyond what agriculturists could pay. The whole future depends upon the prices at which machines can be sold. Under equal conditions

British manufacturers can always hold their own, and, despite the disabilities under which they labour at present, they know that with fair fiscal treatment they have little to fear from foreign competition. One important French firm at the Paris Show exhibited under its own names harvesting and other machines imported from England. When that is possible there must be some gratifying element of vitality in the British agricultural engineering industry.

The "Red Menace" in China.

(From our Peking Correspondent.)

January 3rd, 1927.

No doubt British engineering firms in England who have interests in this country have been, and are still, perturbed about the astounding changes that have taken place recently. These changes are really only the natural sequence of events that have been in the process of materialising for several years, and it is only since the Cantonese have captured the important cities on the Yangtse River that the serious attention of the Powers has been aroused to a situation bristling with possibilities. The undercurrent of "anti-foreignism" that has manifested itself with the arrival of the Cantonese on the Yangtse is naturally a source of great anxiety to all foreigners, particularly the British, who have been singled out as the worst type of "Imperialists." This wave of anti-foreign sentiment may only be a means to an end as far as the Cantonese Government is concerned. The Cantonese Military Authorities have allowed their civilian sympathisers to carry on this propaganda, but it is fairly certain that the day is fast approaching when this unruliness will become a menace to the aspirations of the Cantonese Government and Military Authorities themselves. A similar situation existed in Peking last year when the Kuominchun, headed by Marshal Feng Yu Hsiang, were in control of the Capital. The Kuominchun are Allies of the Cantonese, and they permitted all kinds of anti-foreign demonstrations to take place in Peking until suddenly they realised that such demonstrations were likely to undermine military discipline, and an immediate stop was put to all meetings and demonstrations.

The Cantonese have been compelled to use every possible form of propaganda to enable them to consolidate their position in the Yangtse Valley, and during the past few years all Chinese factions have discovered that the easiest form of propaganda to use amongst their own people is to advocate cancellation of all "unequal treaties" and the placing of the foreigner on the same basis as themselves. In negotiating with Chinese it must be remembered that in the matter of terms they always begin by asking for the maximum, because they are essentially a nation of bargainers, and no doubt in demanding the cancellation of these Treaties they are asking for something they know quite well they cannot get, but in negotiating for their revision they have something to bargain with. That existing Treaties between China and the Foreign Powers require revision there is no doubt, and in marching with the times all must recognise that China is in a position to demand concessions that could not be granted a few years ago. So far as the Cantonese and their Allies are concerned, there is no doubt that at the moment they are more or less doing the bidding of the Soviets, and they will continue to do so as long as it suits them; but, like all Chinese, they are open to bargain with the other side, and if the Great Powers stand together and give them some kind of recognition—subject, of course, to a termination of anti-foreign propaganda—it should not be a difficult matter to bring them over to our side.

There appear to be only two courses open to the Powers, one is to fight the Cantonese and what they pretend to stand for, and the other to make serious efforts to co-operate with them in an attempt to form a real Government. The first alternative can very well be ruled out, whilst the second involves the pocketing of a certain amount of pride on the part of the Powers in an effort to establish friendly relations. On the surface the new British Ministers' visit to Hankow may appear to have been futile, but the best elements in the Southern Party undoubtedly appreciate any sign of friendliness on the part of the Powers, knowing full well that without such sympathy they can never really succeed. In addition to sympathy, practical support must be forthcoming, and this will certainly not be given by the Powers until strikes and boycotts come to an end. The importance of a boycott in China is often exaggerated. During your correspondent's long residence in China many so-called boycotts have taken place, but not a single one instigated by the merchants themselves. Boycotts have always been started by students and political agitators, and they have compelled merchants to refrain from dealing with foreigners, but the merchants have always been glad enough to start trading again in foreign goods as soon as the agitators left them alone. This surely is a healthy sign and must convince one that it is not the moment to shut up shop, as some of the pessimists would have us believe. It is certainly not a moment to be extremely optimistic about the future, but it is the moment to realise that conditions are changing, and changing very rapidly, and that we have to adopt ourselves to new methods.

The large majority of Chinese want to trade, and as foreign trade now plays an important part in China, they cannot afford to eliminate the foreigner. The buying capacity of the Chinese has diminished considerably during the past few years owing to the civil wars, which have brought about increased taxation without the corresponding increase of trade; but should either of the existing military factions succeed in installing and maintaining a Government that can govern and put the railways into commercial operation again, there should be a big trade boom throughout the country. The change of policy on the part of the British Government has had a good effect, and the British community out here now look forward to the Home Government taking a leading part in Chinese affairs in the future.

Literature.

The Hydrous Oxides. By HARRY BOYER WEISER, Professor of Chemistry at the Rice Institute. International Chemical Series. London: McGraw-Hill Publishing Company, Ltd. 1926.

MOST readers of this book will start with a vague uncertainty as to the meaning of the title, and this is anticipated by the author, who gives a definition of a kind, which may not be satisfactory to some, as an introduction. A hydrous oxide is an unstable hydrate of varying composition, according to mode of precipitation, concentration, temperature, &c. &c. To be more precise, Professor Weiser subdivides a little further, and defines hydrous hydrated oxides, or definite hydrates, with varying affinity for water. In ordinary chemical language, the book concerns the equilibrium of certain metallic oxides and water in cases where colloidal solutions and jellies are formed, and hence the modern theory of colloids can be applied.

The theoretical part leads up to a practical one, concerning tanning, mordants, water purification, cement and the soil. He who expects some startling novelties in the practical part will be highly disappointed—only the nomenclature is changed. For such a young science as the colloidal theory, one must admit that it has got a most formidable terminology, and the author of the book under review leads up to it gently by introducing the various terms in the correct surroundings — ultra-microscopic colloidal particles are micella or ultra-microns, as the case may be, &c. &c. The object no doubt is to draw a distinction between colloidal particles and the molecules composing them, but in the absence of a definite determinant of their size, a name has to suffice. Thread-like micella and globular ultra-microns are just as good as any other names, and will probably be recognised in time, like "gel" and "sol," although at present any author would be a public benefactor who gave a glossary of the terms used by him on these subjects. Like other writers, Professor Weiser gives the substance of the various theories of the structure of "gels," but when mathematical theories are introduced, like Donnan's membrane equilibrium theory, the colloid plays no part. Its application to the swelling of gelatine is only the old story of osmotic pressure and blood corpuscles, where, again, the colloidal membrane plays no active part. When the colloid plays a part, it acts as part of a salt and not as a colloid, and so on. In the deflocculation phenomena the colloid plays the ordinary part of any finely divided dielectric, and so on again. With regard to the various metallic hydrates, we learn a lot about preparation of "sols" by "peptising" in various ways; but the sum total is that when we arrive at the practical application of it all, we get some very scanty information on what was well known before.

There is no doubt that there is a certain common cause why the elements treated together on this basis should form these undefined hydrates as well as they form affiliated groups in other respects, but so far the colloidal theory seems to help us very little. It may be frankly admitted that the kind of research treated in this book is very difficult indeed, as the mixtures of "sols" and "gels" take a very long time for separation and alter with time, and that many of the results obtained are of high interest from a scientific point of view, as probable links in a systematised chemistry of colloids, but that has yet to come. Pythagoras' cycloid theory of the universe was complex, but plausible; but then came Copernicus and the others, and the cycloidal theory was gone for ever, although the basic observations helped the new theory into being. The present colloidal chemists endeavour to surround fairly simple facts with a nimbus of Pythagorean complexity by adopting a strange terminology, forgetting that, should we have a solvent light enough and with sufficiently low viscosity to let colloidal particles settle, and a filter paper fine enough to retain them, we should have no colloidal chemistry at all; at all events, as applied to "sols," which would then be finely divided ordinary matter in suspension. There is the well-known case of barium sulphate, which Professor Weiser cites, which illustrates this point. Like all barium salts, it is typically crystalline, but the crystals quite easily become so small as to keep in suspension for a very long time, and they may even become fine enough to form a "micella" jelly, by grouping as filaments or other enclosing structures capable of holding a liquid phase. Still, this barium sulphate must be identical with the ordinary crystalline precipitate. Every analytical chemist knows that barium sulphate "drags" down, for instance, iron, when it forms. Are we any the wiser by calling this phenomenon "adsorption"? That these minute molecular aggregates have interstices fine enough to retain free ions is extremely interesting and of great importance, but surely this is a matter of dimensions and not of a new form of chemistry. The coagulation of "sols" by electrolytes might in the same way be ascribed to this picking up of ions and electro-static effects. There is no doubt that the framework of modern chemistry is wide enough to enclose all colloidal phenomena known so far, and that the ordinary terminology is rich enough. Professor Weiser has given the world a very interesting synopsis of what has been done by the orthodox circle of investigators, of what they call the chemistry of colloids, with regard to what he calls hydrous oxides. Scientifically, with a limited interpretation of the word, he has succeeded, but his practical illustrations hardly impress the reader with the magnitude of the gain to humanity derived from all this laborious work.

SHORT NOTICES.

The Use of Power in Colliery Working. By John Kirsopp. London: H. F. and G. Witherby. 1926.—Whilst this volume contains a great deal of information about the plant of all kinds used in collieries, the author has placed too much reliance upon material collected from manufacturers, and has apparently employed few or no illustrations which cannot be found in catalogues. As a result, whilst it contains many useful facts, it smacks too much of trade to be taken quite seriously as a "Treatise." It concludes with two appendices, which should prove of some value to the manager, one dealing with Prices of Materials and Stores, 1913–1925, and the other with Wage Fluctuations in the same period upon the compilation of which much labour must have been spent.

The Whitworth Book. Prepared by the Whitworth Society. London: Longmans, Green and Co., Ltd. 1926. Price 10s. 6d.—This book is practically a Who's Who to Whitworth men. The names of 1401 such men, covering the period between 1868 and 1925 inclusive, have been traced, and are given with greater or less biographical details. The volume contains also a complete list of the awards for each year since 1869, when Sir Joseph Whitworth instituted his scheme. The success which has been attained by most Whitworth men, as testified by their records, here printed, is notable. Nearly all of them, as Professor Low says in his preface, appear to have made good, and we agree with him when he says, "had Sir Joseph been alive to-day, it is doubtful whether anything could have given him more satisfaction than a perusal of the records of the men whom he benefited so greatly, not only financially, but by enabling them to stamp their initial success in life with the great name of Whitworth." The volume is the first published first-fruits of the Whitworth Society, which came into being in 1923, and which foregathers periodically for friendly intercourse. We must add that Mr. H. H. Johnson, Wh. Ex., has written an excellent brief memoir of Whitworth, with which the volume opens. Altogether this is certainly a book which will be treasured and honoured by all Whitworth men who hold in veneration the name of their great benefactor.

BOOKS RECEIVED.

Motor Cycling Manual. London: Temple Press, Ltd., 7–15, Rosebery-avenue, E.C. Price 2s. 6d. net.

Schnitte und Stanzen. By Ernst Göhre. Leipzig: Otto Spamer, Heinrichstrasse 9. Price 13·50 mk.

Investigations in Ore Dressing and Metallurgy, 1925. Canada: Mines Branch, Department of Mines, Ottawa.

Edison: The Man and His Work. By G. S. Bryan. London: Alfred Knopf, 38, Bedford-place, W.C. 1. Price 18s. net.

Aluminium Facts and Figures. London: The British Aluminium Company, Ltd., Adelaide House, King William-street, E.C. 4.

Die rationelle Bewirtschaftung des Betons. By Dr.-Ing. A. Agatz. Berlin: Julius Springer, Linkstrasse 23-24 W. 9. Price 7·50 Rm.

Calvert's Mechanics' Almanack, 1927. Edited by F. Nasmith. London: John Heywood, Ltd., 20–22, Bride-street, E.C. 4. Price 6d. net.

The Locomotive of To-day. Eighth edition. London: The Locomotive Publishing Company, Ltd., 3, Amen-corner, E.C. 4. Price 5s. net.

The Chronicles of Boulton's Siding. By A. R. Bennett. London: The Locomotive Publishing Company, Ltd., 3, Amen-corner, E.C. 4. Price 6s. 6d. net.

Annual Report, 1924–25, of the Dominion Water Power and Reclamation Service of the Canadian Department of the Interior. Ottawa: F. A. Acland, Printer to the King. 1926.

Durchlaufende Eisenbetonkonstruktionen in elastischer Verbindung mit den Zwischenstützen. By Baurat Dr.-Ing. F. Kann. Berlin: Julius Springer, Linkstrasse 23-24, W. 9. Price 7·20 mk.

Treatise on Thermodynamics. Third edition. By Dr. Max Planck. Translated by Alexander Ogg. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 15s. net.

Art de l'Ingénieur et Métallurgie. Extract of Vol. V. of "Tables Annuelles du Constants et Données Numériques." By L. Descroix. Paris: Gauthier-Villars et Cie., 55, Quai des Grands-Augustins (VIe.). Price 105f.

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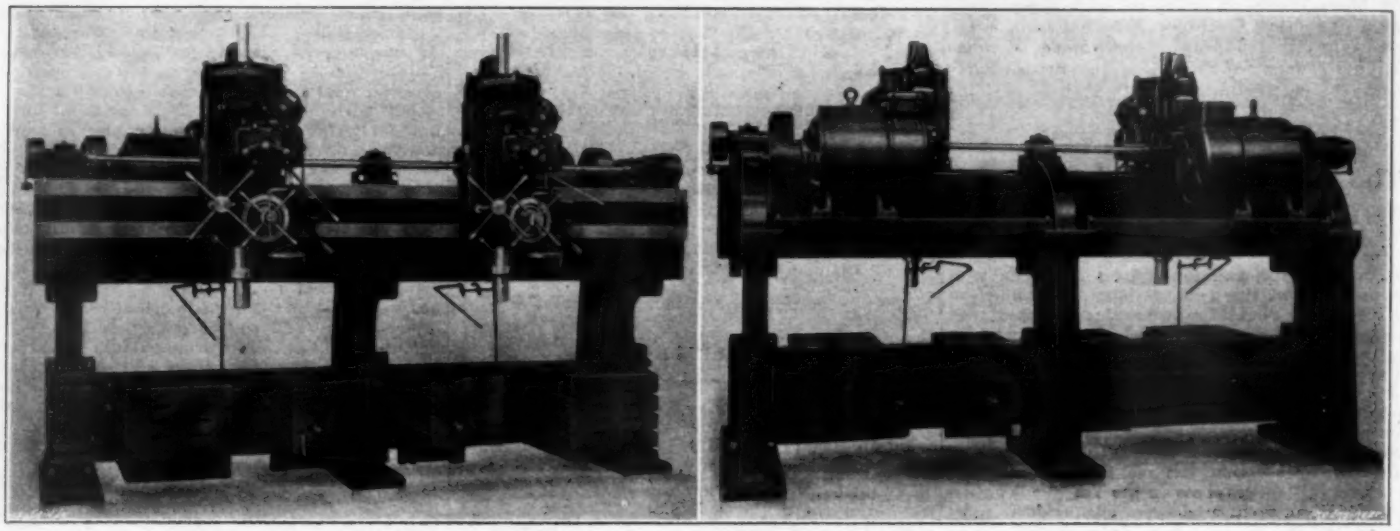


Congella Power Station, Durban.

PULVERISED fuel firing has been decided upon for the new power station which is being erected by the Electricity Supply Commission at Congella, Durban. The system selected is the "Lopulco." The coal it is intended to use is bituminous, its price being about 16s. per ton. It is of Natal origin, and is slightly different from that produced in the Transvaal. When the Congella station is completed, it will be the first power plant in South Africa equipped throughout for burning pulverised fuel, and it appears probable that large extensions will have to be undertaken in the near future. The new station, which is about 3 miles from Durban, will, for the fulfilment of present requirements, contain four boilers and four 6-ton pulverising units, complete with all auxiliary machinery. Provision is, however, being made for duplicating this equipment in the future. The boilers are of the cross-drum type, each having a surface of 7150 square feet, provided with integral superheaters of 3000 square feet surface, these units producing steam at 270 lb. per square inch at a final temperature of 700 deg. Fah. These boilers will be provided with the usual water screen and side wall cooling tubes in the combustion chambers, the heating surface being about 600 square feet. In addition to the water cooling, the combustion chambers will be provided with front walls of hollow construction, the secondary air for combustion being passed through the passages so formed. Each heater will be provided with one "Usco" air preheater, having a surface of 17,000 square feet for preheating the air for combustion. Three Weir turbo pumps will be provided for feeding the boilers, each capable of dealing with 187,000 lb. of feed water per hour at a temperature of 210 deg. Fah. In the pulveriser house, which is 40ft. away from the boiler house, provision is being made for four Raymond pulverisers, each giving 6 tons of pulverised fuel per hour, complete with exhausters and cyclones. Two dryers are also being installed, provision being made for by-passing them when the necessity for drying the coal does not arise. The pulverised coal will be conveyed to the bunkers in the boiler house by screw conveyors, capable of dealing with 30 tons of fuel per hour. The ashes will be collected in an ash collector of the sluicing type, supplied by the Underfeed Stoker Company, Ltd. Automatic control will be effected by the Bailey equipment supplied by Industrial Combustion, Ltd., which is also supplying the steam meters and the draught gauges. The contract also includes the supply of the building and the whole of the auxiliaries, viz., fresh and salt water pumps, air compressors, fans and the instrument equipment, as well as the whole of the pipework and two steel self-supporting chimneys.

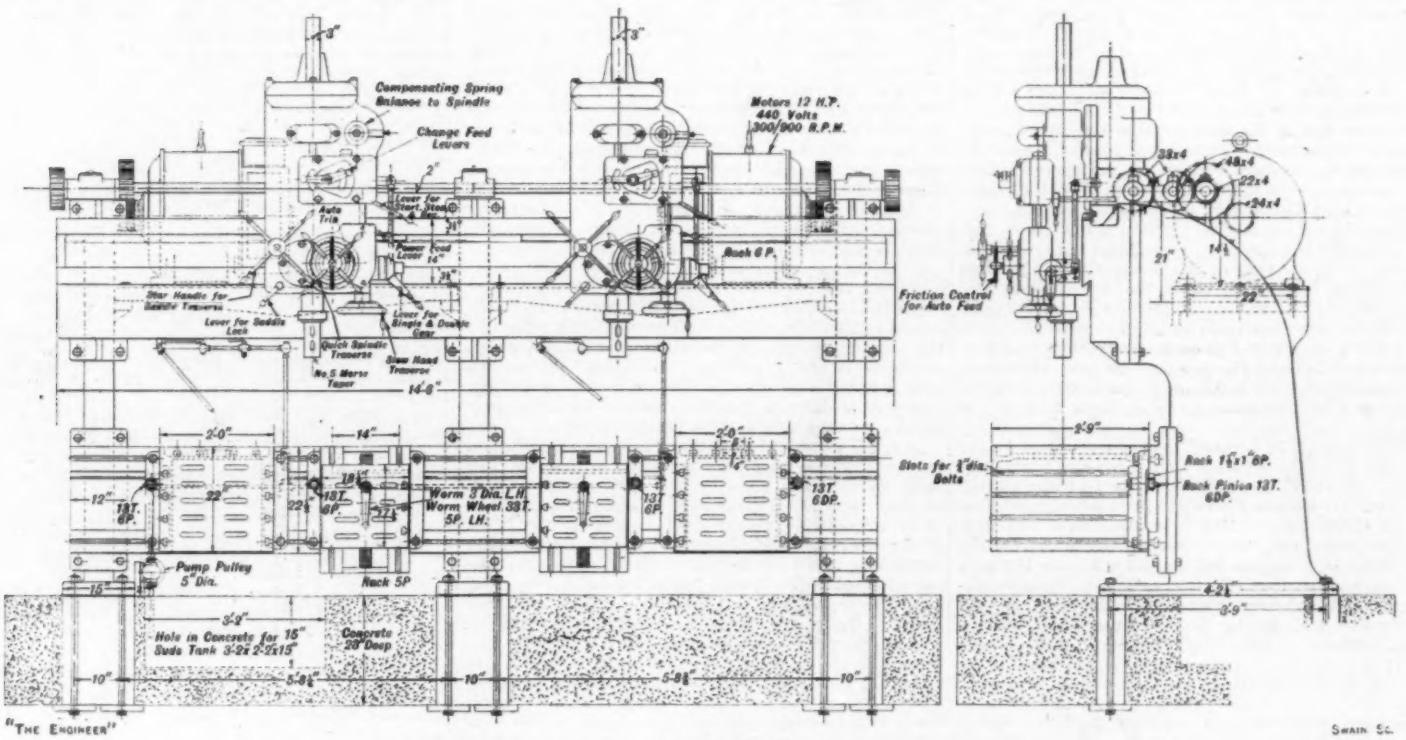
Double-spindle Connecting-rod Drilling Machine.

THE machine tool illustrated herewith has recently been constructed by George Swift and Sons, Ltd., Halifax, to the order of the Bombay, Baroda and Central India Railway for simultaneously drilling the holes in the ends of locomotive connecting and coupling rods. The machine is also suitable for general purposes as a double-spindle, vertical, drilling, boring, facing and tapping machine. It is capable of drilling and tapping holes up to 3in. in diameter in steel and of boring holes up to 12in. in diameter. Under test it was found capable of drilling from the solid 3in. diameter holes in cast iron at a penetration of 3in. per minute, and 3in. holes in steel at 1¼in. per minute.

The two spindles are independently driven in order that holes of different diameters may be drilled or bored simultaneously, each at the most appropriate speed. Each spindle is driven by a 12 horse-power variable-speed electric motor. The outstanding feature of the machine is to be found in the situation given the motors. In machines of this class the motors have previously commonly been placed at the floor level, and have been arranged to drive through gear-boxes on to vertical shafts, which, in turn, have driven through mitres on to the horizontal shafts extending along the top of the main frame. In the present instance the motors—as shown in the rear view of the machine—are mounted on overhead platforms bolted between the frame uprights. By this plan a considerable saving of floor space is achieved, and, in addition, an important contribution is made to the stiffness of the framing by reason of the presence of the platforms.

In the machine illustrated the motors are of variable speed, running at 300 to 900 revolutions per minute. They transmit through a 3 to 1 reduction train on to the horizontal shafts extending across the top of the frame. From these shafts the drive is taken through single and double gearing, and a reverse motion. The spindle speeds thus obtained range from 25 to 300 revolutions per minute. The single gearing gives speeds four times as great as the double gearing, and can be used with the reversed motion in action for backing out taps.

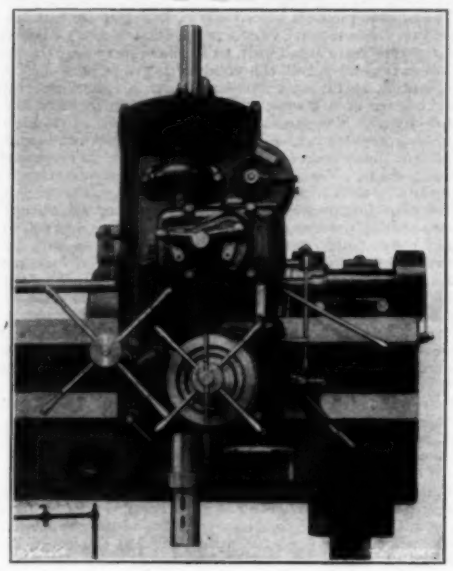
The saddles can be traversed by hand along the cross slide from a maximum spindle centres distance of 10ft. 3in. to a minimum of 2ft. 8in. The spindles are supported in long sleeves fitted with ball thrust washers at both ends. Power and hand feed can be applied to them, and in addition star handles are provided for quickly adjusting or withdrawing the spindles in the vertical direction. Compensating springs are arranged in the upper part of the saddles to balance the weight of the spindles. The power feed changes are obtained through gear-boxes on the front of the saddles. Each box has two handles with three stations, each giving nine rates of feed. These rates range from 30 to 155 revolutions of the spindle per



FRONT AND END ELEVATIONS OF CONNECTING-ROD DRILLING MACHINE

inch of feed. An automatic trip working in conjunction with an indexed dial and a safety stop is provided to prevent the overfeeding of the spindles. The spindles have a total traverse of 18in.

Four tables are fitted to the cross rail at the foot of the uprights. All four can be moved longitudinally by means of rack and pinion gear. In addition to this movement, the two inner tables can be adjusted vertically through a height of 16½in. by worm gear. The tops of the outer tables



ARRANGEMENT OF SADDLE

are bored and recessed to accommodate bushes to suit various diameters of boring bars. The machine will admit a height of 4ft. 6in. between the floor and the spindle noses. Between the top of the elevating tables and the spindle noses a maximum height of 34½in. and a minimum height of 18in. can be accommodated. Between the fixed tables and the spindle noses the height admitted is 23½in.

Electrification on the American Great Northern Railway.

FROM time to time many alterations have been made on American electric railways, and the latest is a change from three-phase to single-phase operation on the Great Northern Railway. The undertaking involves re-equipping the system between Tye, Washington, at the western end of the Cascade Tunnel, and at the eastern portal of the tunnel, and an extension of the electrification westward to Skykomish, Washington. The scheme will involve increasing the electrified lines from 4 to 24 miles, exclusive of the yards, but at a later date the electrified system will be still further extended through a new tunnel from Gold Bar to Wenatchee, when the length of main line track electrified will be 96 miles. In order to secure the advantages of alternating-current distribution and those of the direct-current traction motor, the motor generator type of locomotive was chosen. Twenty-five cycle current at a pressure of 11,000 volts will be drawn from the overhead trolley wire, and all the advantages of high-pressure alternating-current working, such as minimum loss, the use of unattended static transformer sub-stations, &c., will be obtained. In view of the fact that the original three-phase system, as used on the Great Northern Railway, involves the employment of two overhead wires, it is not surprising that when it was decided to extend the electrification of the line it was deemed advisable to abandon this system and to employ the more simple and more convenient single-phase system.

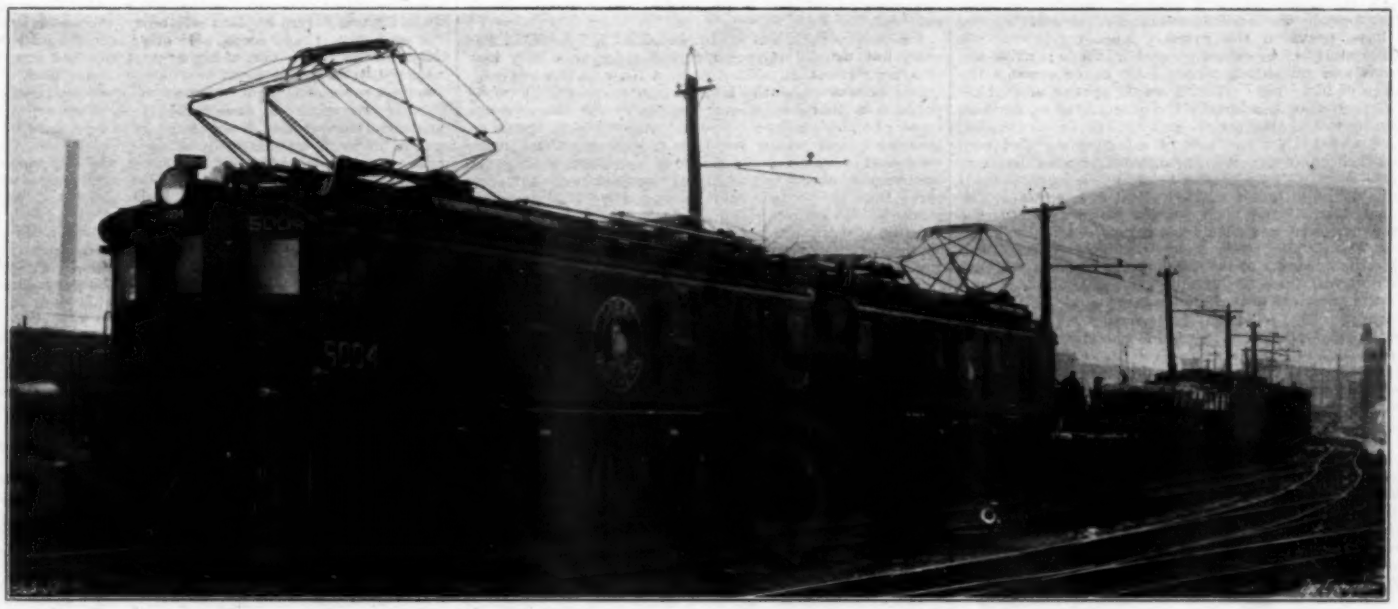
Bearing in mind, however, that the motor generator locomotive imposes no restrictions on the frequency of the high-pressure current, and that a periodicity of 60 cycles is the standard commercial frequency in America, there appears at first sight little justification for using 25-cycle current. There were, however, several governing factors which led the engineers to choose the lower frequency. In the first place, it will be possible to utilise the full 6000-kilowatt capacity of the Tumwater plant, for on account of the liberal design of the machines at that station they are capable of developing their full output when working as single-phase machines. Secondly, some kind of rotating apparatus would have been required to convert the single-phase load into a three-phase load on the power system supplying the energy. Thirdly, a periodicity of 25 cycles is standard for railway transformers, and also for other traction equipment that has been developed. Fourthly, the low periodicity is better from the point of view of reducing interference with communication circuits. Fifthly, on fluctuating loads the regulation of a 25-cycle system is better than that of a 60-cycle system, and the losses in the former case are also less. Lastly, the higher periodicity would require a copper return, because of the higher impedance of the rails. On account of the flexibility of the motor generator locomotive, it will be possible to operate at practically an unlimited number of speeds. The method of accelerating a train by means of voltage control is very advantageous as regards the demand imposed on the power stations, and by using a synchronous motor to drive the motor generator set on the locomotive power factor correction is obtained. When utilising regenerative electric braking, the same flexibility of control is available as when the locomotive is drawing current from the line, and it is possible to regenerate at all speeds within the established range of the locomotive, down to practically standstill.

Two new Baldwin-Westinghouse electric locomotives built for the Great Northern consist, as shown in the accompanying illustration, of two cabs which are self-contained, and may be operated separately. Each engine weighs 715,000 lb., and has a continuous rating of 88,500 lb. tractive effort at a speed of 15·5 miles per hour. The maximum speed allowable is 37·5 miles per hour, and the maximum rating practically 7000 horse-power.

The Great Northern Railway has contracted with the Puget Sound Power and Light Company to supply all the power for operating the system, and under the agreement the Tumwater generating plant will be operated by the company and will be linked up with its system through a 44-kilovolt railway line transmission, and possibly later by its 110-kilovolt line running by another route over the mountains to Wenatchee. The present scheme involves the construction of a 110-kilovolt three-phase 60-cycle transmission line from the Beverley sub-station of the power company near Everett, Washington, to Skykomish, and the erection of two new outdoor sub-stations at Scenic and Cascade respectively. A frequency changing set will also be installed in the Skykomish station, where connection is made with the 110-kilovolt transmission line of the power company and the 44-kilovolt transmission line which is being erected between Skykomish and Tumwater.

Careful consideration has been given to possible interference with signals and communication lines. The direct-current signal system will be changed to a 60-cycle alternating-current system, and the telegraph and telephone lines will be replaced by cables or will be removed from the right of way. On account of the conditions of the contract, which calls for the simultaneous measurement of demand at two widely separated points, the question of metering has presented some interesting problems to the power company.

Simultaneously with the reconstruction and extension of the original electrical section of the line, a new tunnel is being built through the Cascade Mountains, and when it is completed it will be the longest railway tunnel in America, its actual length being 7¾ miles.



GREAT NORTHERN RAILWAY, AMERICA, SINGLE-PHASE BALDWIN-WESTINGHOUSE ELECTRIC LOCOMOTIVE

The Use and Economy of High-pressure Steam Plants.*

By Professor A. L. MELLANBY, D.Sc., Member, and Professor WILLIAM KERR, Ph.D., Member.

THOSE who spend their energies in the attainment and consolidation of minute daily gains in any field of effort seldom take the leisure to examine the nature and value of the main progress achieved or the extent and difficulty of the movements ahead. The confusion of the present obscures both the memory of the past and the prospect of the future. But it is well at times to view the wider reaches of the fields we traverse, and endeavour to discern their fuller promise and their ultimate boundaries.

The present paper is of this general character. Its title offers a scope at once enormous in extent and alarming in detail. But the authors see their task as one of summary and review; wherein selection is more important than comprehensiveness, and directness more to be desired than profundity. While the rights of summary allow the suppression of secondary matter, the demands of brevity compel the same procedure. And so may be considered justified any later apparent neglect of matters that, although important in themselves, are still secondary to the salient aspects of a large subject, noteworthy alike in its vitality of progress and its significance in modern civilisation.

The steam power plant of the near future is rapidly evolving itself out of the apparent confusion of the present under the conjoint influences of necessity and trial. The clamant demand for mechanical power compels progress in the arts and methods of its provision. The gathering masses of ordered knowledge and a finer appreciation of their meaning engender belief in all the promised gains; while the advancing standard of engineering technique renders elaborate and comprehensive trial a possibility. Finance, no doubt, sees all the potentialities, and quietly permits a costly expenditure in expectation of adequate returns.

Behind all the effort is the consistent belief, created by the vastness of electrical power requirements on land, of the value of the "super-everything" plant—high unit power, high pressure, high temperature. It is sometimes difficult to discern whether the promised economies are thermal or commercial, or both; but the driving impulses towards the economic goal have perhaps received an added force by the ready assimilation in modern political economy of the doctrine of a high ratio of mechanical power to industrial population. And so, even Governments have become active in promoting progress and controlling change, with the consequence that primary power problems on land are ascending from a purely local and somewhat haphazard standard to the status of political questions of supreme national moment.

Such open recognition means fairly complete freedom of technical advance in all the main methods of power development; and the extraordinary strength of the general movement towards much more severe conditions in steam plants, besides showing the readiness and enlightened outlook of the steam power engineer, demonstrates the supreme position of this type in the power field of to-day.

But while, undoubtedly, the initial motives, the leading steps and the most courageous experiments are to be found in large-scale land power plants, any success or partial success therein will react directly on all forms of steam plants. The applications of the successful high-pressure steam system are only limited by the actual uses of steam. And these are truly wide and varied. Strictly, the line of progress lies only in so far as steam is the agent of power development; but while there are certainly other uses for steam in industrial operations, these operations can be so allied with the power process as definitely to share in the gains in prospect.

THE FIELD FOR HIGH-PRESSURE STEAM PLANTS.

High-power Land Plants.—In the larger power plants on land a mere decade has seen the progression of boiler pressures from 250 lb. through 400 lb. and 600 lb. per

* The Institution of Mechanical Engineers.

square inch to actual, though isolated, cases of 750 lb. and 1200 lb. per square inch, with projected attempts at 1500 lb. and even 1800 lb. per square inch, and experiment beyond even these values. The same period has marked the increase of temperature from about 600 deg. Fah. to a present fairly definite level of 750 deg. Fah.; but with a few foregin stations displaying a high courage and utilising temperatures in the region of 800 deg. to 900 deg. Fah. The power unit output has grown from an average of roughly 15,000 kilowatts to sets of 50,000 and 60,000 kilowatts, while reports in the technical Press indicate that a turbine generator unit of 208,000 kilowatts is under process of construction by the General Electric Company at Schenectady for the State Line Generating Company on the Lake Michigan shore. Boilers have developed at more than a relative rate; a generation of 300,000 lb. of steam per hour is neither impossible nor untried; and condensers and condensing equipment have easily kept abreast of all these requirements.

These are striking manifestations of progress, especialy in view of the relatively fixed conditions of the earlier years, and it may well be asked what aspirations prompt such efforts. Advances of such a nature certainly show that there is nothing moribund about the steam plant in this all-important field.

This is the more notable in that at a date well within the period mentioned there was a commonly expressed belief that the steam plant must give way to some extent before the water power plant and the internal combustion engine. The first promised cheapness and a lasting source of energy. The latter had been—and still is—phenomenally and economically successful. Both have had to moderate their challenge in face of the sheer magnitude of the task; and now neither can offer more than a local strength of opposition.

There have been several estimates of the probable growth in electrical power demands in this country within the next ten or fifteen years. The prophecies vary around a three-fold or four-fold increase. Obviously, water power can have little say in the attempts to meet any such enlargements. Even in America, so well provided with the bounties of nature, the present developed one-third proportion of the potential water power represents only about one-quarter of the total present demand; and the demand will assuredly grow at a greater rate than the exploitation of the remaining water power.

Hence only the steam plant can really offer the prospect of satisfying the call. The internal combustion engine is a relatively small power unit confined to other fields. The internal combustion turbine looms up as a vague hope; but, even if that were satisfactorily achieved, it cannot possibly have the economical qualities of its reciprocating progenitor, and is therefore the less likely ever to prove a really strong competitor of the steam plant. Further, the very factor of materials that really limits the ultimate boundaries of the steam plant, seriously restricts the first development of the internal combustion turbine.

In a recent scrutiny of the land power field, Sir John Snell[1] has foreshadowed great increases, and states that there is an expansion in prospect "which can only be met by a much larger conception of the methods of generation and transmission than have hitherto been adopted." Since the methods of generation must be mainly by the steam plant, the "larger conception" really postulates the necessity for the most economic processes. What are the causes of this drive towards higher orders of economy, and what hindrances may be expected to impede the advance?

While the huge, and still growing, demand for electricity supply by the conditions of modern life and industry may have provided the primary opportunity for the intensive study of more economical methods; while the apparent and immediate desire may be to counter the influence of high fuel costs; it would appear undoubted that the movement is largely the outcome of a universal awakening to the absolute necessity for fuel conservation. The somewhat altruistic aim of safeguarding and conserving fuel resources is the fundamental motive. In many ways the altruism may appear belated; in many cases it is probably quite unappreciated. But it is certainly the most satisfactory and most certain justification for the costly experiment and development now so widely undertaken. The parallel study of low-temperature carbonisation is a further proof of the necessity and further evidence of the motive.

But the questions of fuel economy are supposedly mixed up with those of costs and fuel charges. The thermal gains are only considered justifiable in so far as they lead to a reduction of the charges. Sir John Snell has given it that the fuel and capital charges in an up-to-date plant are about equal at 40 per cent. each of the total. In American stations it is highly probable that the capital charges may exceed those for fuel. If the demands of fuel conservation are allowed to intrude into this, some degree of delicacy is created. For, if financial costs represent always the controlling factor, it would be no easy matter to justify the elimination of many obsolete plants which have been fully written off in the course of time. It is also probably true that in the first stages of development, many pioneering stations of the new order may not prove highly successful in the financial sense. Is fuel economy to be stayed by such considerations, or is financial gain to be limited by thermal measures of excellence?

Some time ago in Glasgow there was a newspaper controversy regarding the merits of two city stations. One developed power on more money and less coal than the other. On the highest basis of judgment, which was superior? The issue mixes two standards of measurement. It seems hardly possible to measure a performance of this nature, simultaneously and without confusion, in the arbitrary currency of men and the absolute coinage of nature. Perhaps the judgment of posterity may be a little less uncertain.

It has been remarked that primary land power has developed a political aspect and value, and, in view of that, fuel economy must become the dominant call and commercial values adapt themselves, as always, to the circumstances, and find new levels that are at once secondary and satisfactory. Achievable and proved fuel gains will carry in their train an automatic cheapening by enlarged development. The extreme significance of large-scale power in industrial and domestic affairs, and the recognition that it has national aspects that eclipse the immediate, the parochial, or the purely speculative questions of finance are the lessons of the situation. No country engaged in the keenly competitive matters of modern life can afford either to lag behind in the extension of power supplies or recklessly to sacrifice national resources in the development thereof.

The various questions are still further confused by the problems of load factor, and the main steps towards commercial improvements must, no doubt, be in the increase of this important value. Whether it can be so increased by the large idea of full interconnection of power plants, or by such lesser ideas as that of, say, the "all-electric house," remains to be seen. If the lesser idea mentioned is assumed to be a permissible method, the question of fuel economy might again be introduced by the query as to whether house-heating by processes strictly circumscribed by the second law of thermodynamics is really to be reckoned efficient or ideally profitable.

The authors are aware—from past experience—that studies of the kind in hand are liable to be considered nullified in meaning or value by the casual introduction of questions of cost. In anticipatory defence, therefore, they submit the point of view that in land power development on the large scale the ultimate aim must be the achievement of the highest thermal economy open to engineering skill and consistent with plant reliability, and limited by these only. In this view, the large field of the central station power plant becomes, even in the absence of any really notable competition from other types, the best and most appropriate field of effort for the ardent exploitation of any virtues inherent in the high-pressure steam plant, and the one in which its promise of thermal economy has the highest application, meaning and value.

Industrial Power and Process Plants.—In the case of the smaller industrial installations, there are two different kinds of circumstances. Either the industry has waste heat—as in iron and steel works—from which it may develop its own power through the medium of steam plants, or it demands steam for process work—heating, evaporating, &c.—and may utilise the steam for power development before passing it to the essential duties. The former provides the combination of the ordinary turbine with the special "waste heat" boiler, while the latter presents the conjunction of the ordinary boiler with the special "bleeder" turbine.

The applicability of high pressures is fairly obvious. The whole of this wide and diverse field is open to attack by the high-pressure plant on the successful outcome of the efforts made in the high power field. The development of power from waste heat stands to gain in the same degree as that from fuel, since the use of the steam so generated is similar in the two cases, and requires the same kind of plant. Gains of this kind permit of a fuller degree of electrification within a plant, and a higher achievement in the matter of internal power resource and self-containment. Alternatively, surplus power may even be developed and the unit might become an item in a scheme of interconnection and sell power in addition to products.

The conditions in process plants are extremely varied. But given the proved success of high-pressure working, they could actually reach higher relative gains than with pure power plants. The economies of high-pressure steam increase relatively as the plant back-pressure rises, and since all heating systems are back-pressure systems, the margins for power production are correspondingly enlarged.

In the process plant steam must be generated in any case, but usually its main function requires only low-pressure generation. The difference between this low functional pressure and the high values envisaged in power practice is therefore directly available for the development of "by-product" power. Again, with the high-pressure plant, steam could be tapped from the power unit over a much wider range of conditions, and even processes requiring much higher temperatures and pressures than the usual could be served from what would really be the lower turbine ranges. Also, if higher steam conditions than are now customary can be utilised in established lower pressure methods, the size and cost of the process plant might be considerably reduced.

The main difficulties in the way of the ready adoption of high pressure in such directions lie in the limited sizes of the power units involved, and in the incidence of costs. At the more extreme pressures the problems of successful turbine construction call for rather large capacities, which will hardly ever be a requirement of the single industrial system. The solution here will no doubt be ultimately reached by the perfection of high-pressure units as experience is acquired in large installations; but until that stage is reached the difficulty will react on the maximum allowable pressure and keep it well below the thermally economic limit.

On the other hand, the fact of this difficulty may lead to some development of the distribution of heating steam from central stations. Thus the Rochester Gas and Electric Corporation in America has a 380 lb. per square inch plant exhausting into distributing mains at about atmospheric pressure, with these mains supplemented by high-pressure supply for the peak loads. Such a method, however, would only seem possible for the heating of buildings, whereby the concentration of a large aggregate demand may be possible.

The question of costs will always exercise an important influence in industrial plants. But the relation of thermal economy is here entirely different from that which has been emphasised in connection with primary power plants. Since the heating process is the essential function, high fuel economy is really assured, by the utilisation of the latent heat, in the performance of that essential. The use of high pressure is therefore a mode of increasing an already high figure, and the assessment of the merits of any such procedure involves a proper accountancy, which will charge the heating plant with a gain through the production of augmented power, rather than consider the power plant as losing through heavy extraction for process operations. The accountancy requires a clear view both of thermal and commercial factors; but in this type of plant in particular, the arbitrary judgment of the individual and the existence of fully depreciated plants introduce factors that tend to confuse the thermal and simplify the commercial aspects.

The industrial plant may, then, prove rather slow to benefit, and because of the many and confusing conditions it is unlikely that it will ever utilise the highest pressure values and their accompanying plant elaborations. But although the effort has hardly commenced, the scope is quite clear and the promise conspicuous.

Marine Steam Plants.—In marine work the situation is again quite different; but even from this different standpoint the opportunity for the high-pressure steam system is obvious and far-reaching.

The marine plant is essentially a power unit, but the individual installations vary over a wide range of capacity, the relatively small unit, as in the cargo vessel, being the more general. But the condition of affairs is highly complicated, so far as the steam plant is concerned, by the existence of a strong competitor in the form of the Diesel engine. The strength of the latter lies in its high thermal economy; while under ordinary steam conditions the steam plant scores in its easier adaptation for high-powered ships. There can be no claim that under such conditions it equals its opponent in efficiency.

The situation, however, is liable to rather an abrupt change if the present-day practices in steam operation should prove fully effective. The steam system will, by the mere repetition of the special and advanced features of the modern land plant, obtain a new grip on the field which it originally created, and an enhanced strength of opposition against its rather determined supplanter.

The only method whereby the steam plant can achieve this lies in its economical improvement to a pitch at which it is on open and obvious equality with the internal combustion engine. This equality is promised by high-pressure conditions, and the certainty that the tendencies in land plants would be rapidly copied and tried in marine work is amply demonstrated by the recently completed Clyde steamer King George V., with its unique and apparently successful 550 lb. per square inch system.

While the task before the marine steam plant is the achievement of a higher overall thermal economy, the test of success is by comparison with Diesel performances. In this respect it is necessary to realise that the grades of fuel differ; and hence it is not essential that the same absolute thermal efficiency should be attained. Steam conditions and practices well below the severe standards attempted in land work will probably be quite sufficient, and the full development of re-heating elaborations and numerous feed-heating extractions will be unnecessary.

Sir John Biles has recently[2] carried out a very detailed comparison of relative values employing steam figures easily within the bounds of immediate endeavour. With all factors included, his results are highly impressive, as showing the margins of advance readily open to the steam plant, and how easily it may be brought abreast of the Diesel engine drive, even in the case of cargo boats wherein the latter is supposed to have very special merits.

The capital charge factor is definitely in favour of the steam vessel, even with the additions due to the more expensive arrangements for high pressure. This has a strong bearing on running costs which will always provide a leading criterion of choice. Sir John Biles's results show that the running costs of the Diesel engine and the oil-fired turbine boats are very much alike, with the latter operating on moderately high pressures. The Diesel equipment shows a slight superiority in the matter of long runs, although the length of run at which the critical change occurs increases very rapidly with tonnage.

In the other primary requirement in marine practice, of the highest degree of plant reliability, the steam system will probably always score, and after a few initial difficulties in the application of higher pressures and temperatures—such as engine-room ventilation—have been overcome, its superiority in this respect will be fully apparent. Further, the ultimate developments in marine practice must raise the question of the ability of any primary power system to work satisfactorily in conjunction with transmission devices, and in this respect the fundamental superiority of the steam turbine over any reciprocating engine type, entailing essential irregularities of action must be admitted.

In all therefore it is possible to conceive the whole of this important power field being open to successful exploitation by the high-pressure steam system. The difficulties are those of keen competition rather than achievement; and of poorness of opportunity rather than lack of promise. The partial eclipse of the Diesel engine by the steam plant, following rapidly on the partial eclipse of the steam plant by the Diesel engine, may prove a somewhat spectacular event, and may leave a single generation of marine engineers in more confusion of thought and method than the aggregate difficulties of the marine past could show on total summation.

The Steam Locomotive.—The steam locomotive bears at present somewhat the same relation to the marine plant that the power side of an industrial process scheme bears to the central station outfit. It is, in general, a much smaller power unit employing high back-pressure conditions. Consequently, it is definitely open to gains by the adoption of high-pressure and high-temperature working.

To a certain extent superheating has always been employed in this connection, and total temperatures of the order of 600 deg. to 700 deg. Fah. are not unknown. In this respect, then, practice may be said to utilise a feature of the modern scheme; but high pressures are rare—although occasionally used—and the other refinements of the present-day steam cycle are unknown.

Locomotive design has, however, proved extraordinarily conservative, and by far the largest proportion of new engines follow moderate pressure conditions with atmospheric exhaust. Such methods are open to attack in several ways, and both electrification schemes and internal combustion engine arrangements make fair headway. Yet it must be admitted that the old type steam locomotive displays a remarkable tenacity, in spite of its obviously wasteful methods and the competition of these other systems.

The application of the full scope of high-pressure steam methods is, however, not so easy or direct in this connec-

[1] "The Present and Future Development of Electricity Supply," Brit. Assoc., 1926.

[2] "The Relative Commercial Efficiency of Steam Turbine and Diesel Machinery for Cargo Vessels," "Trans.," Inst. N.A., June, 1926.

tion as in the other fields mentioned. The primary problem lies in the adaptation of the steam turbine to the requirements of the type, and this at once brings into the situation the questions of suitable condensing and satisfactory transmission systems. The condenser problem alone is serious; but has really nothing to do with high pressures. Many types have been tried—air types, film types, spray types, &c.—but development shows a strange inertia that seems to betoken fundamental difficulties.

While, therefore, the high-pressure gains are in the main open to the locomotive, the low-pressure economies are quite untouched, and there is no other type of steam plant in use to-day confronted with such strong potentialities of increased economy. Hence the development and application of higher pressures—that are directly possible—may confer the additional advantage of directing a closer attention to low-pressure conditions and the means of achieving the benefits that lie therein.

The consideration that has been given to the different fields in which steam power plays its important part is of necessity general, but from the mere enumeration of the various cases it should be easy to realise the supreme significance of the present movement towards high-pressure steam conditions. The movement has, besides its high aim and great promise, an extraordinary scope, and, having obtained some view of this scope, more detailed matters regarding the subject may now be considered.

It should be appreciated, however, that the immense range of the subject embraces a wide variety of features which, although of great interest, are only open to descriptive treatment, and consequently for the sake of definiteness attention must be mainly confined to those questions that are amenable to some degree of critical scrutiny.

(To be continued.)

Institution of Mechanical Engineers.

NORTH-WESTERN BRANCH.

AT the annual general meeting of the North-Western Branch of the Institution of Mechanical Engineers, held at the Engineers' Club, Manchester, on Thursday, January 20th, Mr. Leonard F. Massey was unanimously elected chairman for the ensuing year, to succeed Mr. C. Bentham, whose term of office had expired. Mr. H. Richardson was elected honorary secretary, in place of Professor Dempster Smith, who has resigned the office; Messrs. Malpas and Molyneux were re-elected on to the Committee, together with two new members, Messrs. G. E. Bailey and Professor Scholes. In acknowledging a vote of thanks for his long service as honorary secretary, Professor Dempster Smith said the branch had grown beyond all expectation, the meetings during the session had been well attended, and the affairs had been well administered by the local Committee. He gave up the work with regret.

Upon the conclusion of the formal business, a paper on "Small Turbine Units for Industrial Purposes," was read by Mr. G. Arrowsmith, M.Sc. Tech. The author treated the subject with special reference to the cotton industry, for which, he said, the type of unit generally most suitable was a small turbine running at a comparatively high speed, and driving through reduction gearing. In cotton mills the power requirements were said to vary from about 800 horse-power upwards, with a steady load throughout the day, while a certain amount of steam was required for heating the mill by day and night and at week-ends. In paper mills the power requirements were less steady, and, in addition, there were large demands for process steam at from 30 lb. to 60 lb. pressure. In these cases the heat extraction or pass-out system was necessary for the maximum economy. In dyeing and bleaching works, the author said, process steam requirements frequently exceeded power requirements, and so turbines of the back pressure type might be used, the whole of the exhaust steam being usefully employed for manufacturing purposes. In other cases, where the power and heating steam did not synchronise, a pass-out turbine might be effectively employed, although as an alternative there was also the possibility of embodying a heat accumulator, thus levelling out the peaks in the demand on the turbine for heating purposes.

The author then went on to consider the use of the straight-through high-pressure turbine without steam extraction, of which there were four main alternatives:—(1) Steam turbine with reduction gears and a direct-driven rope pulley; (2) turbine with turbo- or gear-driven alternator and motor equipment; (3) combination of gear-driven rope pulley and gear-driven alternator; and (4) motor equipment and power supply purchased from an outside source.

The author said that although the small power unit was far behind the large power station in fuel economy, since fuel cost represented so small a proportion of the total in electric power production, a very wide margin was still left in which the small commercial unit might overtake its competitor. A further point had to be considered in electric power production and supply, compared with the individual industrial unit. The variation in load on an average power station was very wide and power equipment must be installed to a capacity well in excess of normal peak loads. An industrial power plant was installed to meet an accurately defined load condition, which persisted at a comparatively constant value throughout working hours. The result was reflected in capital charges, and it was those points which, in spite of considerably lower thermal efficiency, rendered the small straight-through steam turbine unit a thoroughly sound commercial proposition in a large number of cases.

Having gained an accurate knowledge of the coal consumption which was the main item in the running costs of an industrial plant, said the author, the item of second importance was that of capital costs involved, since it affected the allowance to be made on running costs for interest and capital repayment. The expenditure involved in the renewal of a power plant must vary in practically every case, according to the conditions to be met, and, consequently, any generalised results could only be taken as extremely approximate. From the analysis of costs involved in a large number of schemes for re-equipment, a reasonable figure appeared to be £8 per horse-power of plant installed. That figure included foundations and reasonable minor structural installations, in fact, for the complete expenditure providing suitable boiler plant existed. For installing Lancashire boilers, should they be necessary, a further £2 10s. per horse-power might be allowed. For the installation of motor equipment, including cabling, distribution boards and suitable foundations and alterations to drives, an approximate figure of £4 per H.P. could be taken. It was emphasised that generalised costs on a horse-power basis could only be approximate, but they represented the case sufficiently well to indicate the effect of capital charges on running costs. Taking the cases of a turbo set for rope driving and a motor equipment suitable for purchased power supply, the main items involved in the running costs of both could easily be laid down, and from them it could be seen at what approximate price power supply must be available for the electrification scheme to compare with the direct drive.

The author gave as an example a 2000 H.P. plant installed to meet an average load of 1850 B.H.P., the mill also requiring 13 tons of coal per week for heating and other purposes:—

Working Costs with Turbo Rope Drive.

	£
74 tons of coal per week at 22s. per ton for fifty working weeks	4070
Engine-room attendant (driver mechanic), at £3 10s. per week	175
Fireman, £3 10s. per week	175
Ash wheeler, £2 per week	100
Minor engine-room stores	25
	£4545
Capital expenditure, £16,000; interest, capital repayment and maintenance at 11 per cent.	1760
	£6300

Working Costs with Electrical Equipment.

	£
Heating cost, 13 tons per week at 22s.	715
Motor plant attendant at £3	150
Fireman, £3 10s.	175
	£1040
Capital expenditure, £8000; interest, capital repayment and maintenance at 11 per cent.	880
	£1920

Difference between two schemes .. £4380

This difference was available for purchase of electrical power. Assuming that 90 horse-power in the rope-driven scheme was required for condenser and boiler plant auxiliaries, the equivalent electrical load would be 1400 kilowatts. That, for the 2400 working hours per year, would represent 3,360,000 units, and would require to be available at a price of 0·306d. per unit to give the total cost of £4380, as obtained by the difference of the two schemes.

Similar estimates could be made for combined rope and electrical drives or for electrical drives throughout, with turbine-driven alternator installed. The results on these two alternatives, although not showing quite so large an advantage for the small power unit, still indicated that until power supply was available at a figure approaching ½d. per unit, there would exist a wide field for the application of an efficient small power unit as typified in the industrial type of turbine plant.

WATERTIGHT FITTINGS FOR INCANDESCENT ELECTRIC LAMPS.

THIS British Standard specification for water-tight fittings for incandescent electric lamps, which has just been issued and which is a revision of the 1920 edition, applies to fittings of the bulkhead and well-glass types for use in conjunction with British Standard Lamps (B.E.S.A. Specification No. 161), having an overall length not exceeding 150 mm. and 140 mm. respectively.

The general clauses deal with the material, finish of material, wire entry, earthing screw and lampholder, whereas the sectional clauses deal mostly with dimensions, packing rings and gauging. The dimensions standardised are those essential for interchangeability, but the full details of the design of the fittings are not standardised. It is mainly in the latter feature that the present specification differs from the old edition, wherein the details of the design were very minutely specified. The general construction is now left in the hands of the manufacturer, who can thus work to his own design within the limits imposed by the dimensions necessary for interchangeability. These dimensions are clearly shown on a series of drawings covering several types of bulkhead and well-glass fittings. An important item in the specification is the standardisation of the screw-thread on the guard and in the body of screw-guard fittings, this being of Whitworth form with sixteen threads per inch. In the past great inconvenience has been experienced owing to the existence of an alternative screw-thread having nineteen threads per inch, and the universal adoption of the present standard will be to the benefit of both users and manufacturers.

Copies of this new specification may be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, S.W. 1, price 2s. 2d. post free.

CALENDARS, DIARIES, &c.

BURTON, GRIFFITHS AND CO., Ltd., 64/70, Vauxhall Bridge-road, S.W. 1.—Wall calendar with monthly tear-off sheets.

CLAY CROSS COMPANY, Ltd., Clay Cross, near Chesterfield.—Pocket diary for 1927.

D. P. BATTERY COMPANY, Ltd., Bakewell, Derbyshire.—Wall calendar with monthly tear-off sheets.

DELORO SMELTING AND REFINING COMPANY, Ltd., London.—Wall calendar with monthly tear-off sheets.

KENRICK AND JEFFERSON, Ltd., West Bromwich.—Desk calendar with daily tear-off slips.

PENNSYLVANIA RAILROAD COMPANY.—Wall calendar with tear-off sheets.

PRIEST FURNACES, Ltd., 123, Albert-road, Middlesbrough.—Refills for desk calendar stand.

S. S. STOTT AND CO., Lonesside Foundry, Haslingden.—Wall calendar with monthly tear-off sheets.

J. SWAIN AND SON, Ltd., Shoe-lane, E.C. 4.—Wall calendar with monthly tear-off sheets.

Catalogues.

BRUNTONS WIRE ROPE WORKS, Musselburgh.—Booklet on wire rope for cranes.

ALFRED HERBERT, Ltd., Coventry.—Second edition of the booklet "Concentric Chucking."

JOHNSON AND PHILLIPS, Ltd., Charlton, S.E. 7.—Leaflet describing mining type unit switchgear.

P. R. JACKSON AND CO., Ltd., Manchester.—Card illustrating Jackson's double helical speed-reduction unit.

PAUL DIENY, 2, Laurence Pountney-lane, E.C. 4.—Leaflet dealing with the "Ejectowater" air condenser.

HADFIELDS, Ltd., East Hecla and Hecla Works, Sheffield.—Pamphlet 234 dealing with non-corroding steel.

SPECIALLOID LTD., Friern Park, North Finchley, N. 12.—Price list of "Specialloid" pistons for motor cars.

WHITE MACHINE TOOL COMPANY, Ltd., Halifax.—Folder giving particulars of the "White" planing machine.

RUSTON AND HORNSBY, Ltd., Lincoln.—Catalogue No. 4981, giving full particulars of oil engine-driven excavators.

LANGDON ENGINEERING COMPANY (1924), Ltd., Southampton.—Folder illustrating miscellaneous fittings for boats.

GENT AND CO., Ltd., Faraday Works, Leicester.—Book 6, "Water Level Indicating and Recording Apparatus."

MARSHALL, SONS AND CO., Ltd., Gainsborough.—Publication No. 1674, giving full particulars of drop valve engines.

J. BLAKEBOROUGH AND SONS, Ltd., Brighouse, Yorks.—List 102, giving particulars of the "Luc-Denis" expansion joint.

THE ETNA ENGINEERING COMPANY, Effingham House, Arundel-street, W.C. 2.—Brochure on "Bricaniron" lathing.

DUGDILL'S PATENTS, Hazel Grove, Stockport.—Card illustrating various types of light fittings.

HAKOL LTD., 115, High Holborn, W.C. 1.—Brochure giving full particulars of the Hakol-Zwicky process of oil gas production.

MAYOR AND COULSON, Ltd., 47, Broad-street, Glasgow, S.E.—Booklet describing the "Samson" 1927 model chain coal cutter.

SAMUEL OSBORN AND CO., Ltd., Clyde Steel Works, Sheffield.—Price list of all types of "Musket" high-speed steel milling cutters.

G. COHEN SONS AND CO., Ltd., 600, Commercial-road, E. 14.—Booklet illustrating and describing all types of power plant for sale.

RADIO COMMUNICATION COMPANY, Ltd., 34, Norfolk-street, W.C. 2.—List No. X/1226 of Direction-finder equipment, type R.A. 59.

BROMFORD TUBE COMPANY, Ltd., Birmingham.—A sectionalised loose-leaf catalogue describing the company's productions.

MATHER AND PLATT, Ltd., Park Works, Manchester.—A thirty-two-page brochure entitled "Electric Power in the Paper Industry."

C. F. CASSELLA AND CO., Ltd., 49, Parliament-street, S.W. 1.—Catalogue No. 541 of surveying and drawing instruments and appliances.

S. G. LEACH AND CO., Ltd., 26–30, Artillery-lane, E. 1.—List L P 1/26, giving particulars of "Selco" vertical type centrifugal pump.

POWER PLANT COMPANY, Ltd., West Drayton, Middlesex.—List No. 18, describing and illustrating the "Fieux" limiting torque clutch.

R. A. SKELTON AND CO., Moorgate Station Chambers, Moorfields, E.C. 2.—Handbook No. 20 on "Steel Construction." Price 10s. net.

CROSSLEY BROTHERS, Ltd., Openshaw, Manchester.—Publication No. 1039, a list of users' opinions of the "Crossley" petrol-paraffin engines.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., Trafford Park, Manchester.—Circular 1785/9, dealing with loom motors and loom drives.

HOPKINSONS, Ltd., Huddersfield.—List No. 1890, describing the patented sheltered seat "Flexible" try cock, and List 1880 on "Mac" valves.

HATHORN, DAVEY AND CO., Ltd., Leeds.—Descriptive booklet of the Gill "Helwane" and "Helwane" pumps for large quantities and low lifts.

INTERNATIONAL COMBUSTION, Ltd., Africa House, Kingsway, W.C. 2.—Brochure giving particulars of the "Lopulco" pulverised fuel system.

STURTEVANT ENGINEERING COMPANY, Ltd., 147, Queen Victoria-street, London, E.C. 4.—Catalogue 1220 on vacuum cleaning in large buildings.

W. RICHARDS AND SONS, Ltd., Britannia Foundry, Middlesbrough.—Seventh annual issue of the firm's chart of iron and steel prices, 1914–1927.

STANDARD SEALING CHAMBER COMPANY, Ltd., 57, Chancery-lane, W.C. 2.—Brochure illustrating and describing the standard electrical sealing chamber.

CUTBILL, KING AND CO., Ltd., 32, St. Mary Axe, London, E.C. 3.—Booklet describing the "Compulsoreo" self-operating water circulator for boilers.

CINCINNATI GRINDERS INCORPORATED, Cincinnati, Ohio, U.S.A.—Brochure illustrating and describing the "Cincinnati" plunge cut grinding machines.

WALTER MCGEE AND SON, Ltd., Albion Works, Paisley.—Lists No. 110, 111, 112 and 114, illustrating and describing the firm's principal manufactures.

MITCHELL CONVEYOR AND TRANSPORTER COMPANY, Ltd., 45–50, Holborn-viaduct, E.C. 1.—Folder showing recent developments in wagon unloading devices.

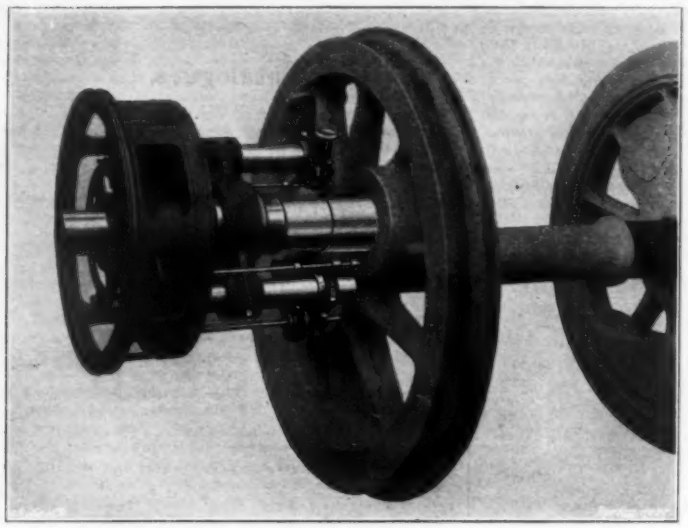
NATIONAL GAS ENGINE COMPANY, Ltd., Ashton-under-Lyne.—Catalogue No. 225, dealing with vertical heavy oil engines for crude, residual, refined and tar oils.

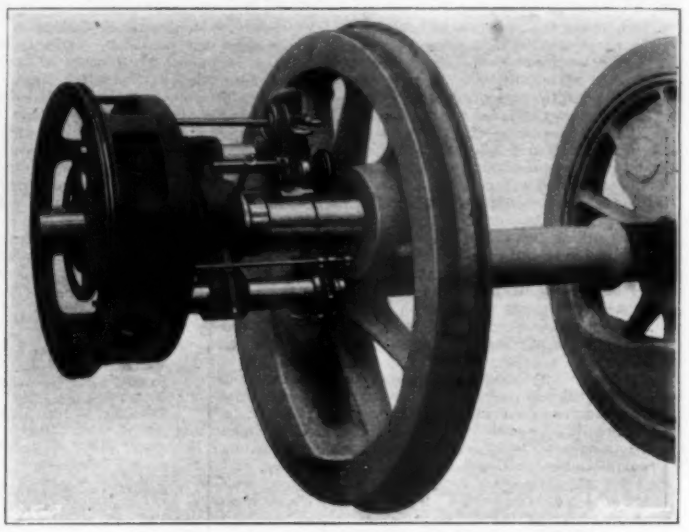
BROOM AND WADE, Ltd., High Wycombe.—Catalogue B, giving full particulars and illustrating the various types of air compressors made by the company.

THE NORTH BRITISH LOCOMOTIVE COMPANY, Ltd., Springburn, Glasgow.—Illustrated description of the first British geared steam turbine condensing locomotive (Reid-MacLeod system).

CRANK PIN TURNING AND GRINDING MACHINE

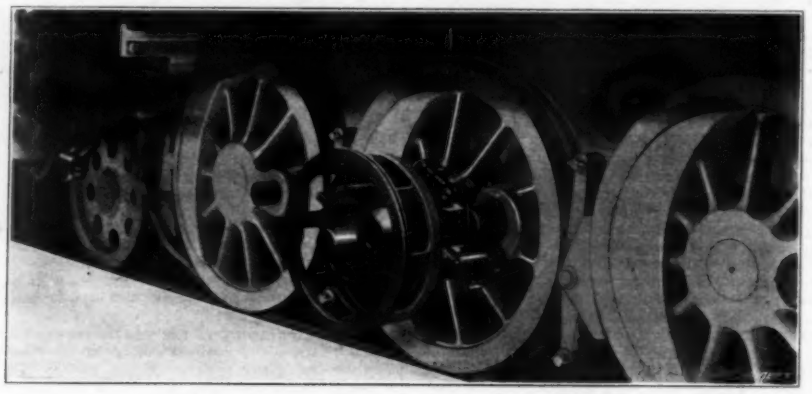
JONES, BURTON AND CO., LTD., LIVERPOOL, ENGINEERS





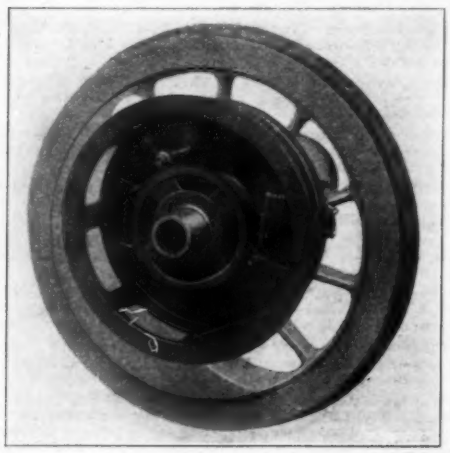
Portable Crank Pin Turning and Grinding Machine.

THE device illustrated herewith is known as Dobson's patented portable locomotive crank pin turning and grinding machine. It is supplied by Jones, Burton and Co., Ltd., 55, Great Crosshall-street, Liverpool. As its name implies, it is intended for turning and grinding the crank pins of locomotive wheels without the removal of the wheels from beneath the engine. The machine is claimed to be self-centering, a feature which is of considerable importance in a device of this kind, in view of the fact that crank pins generally wear to an oval section and do not retain their original circularity.



MACHINE AT WORK ON A LOCOMOTIVE CRANK PIN

The main body of the machine consists of a light casting



FEED GEAR ARRANGEMENT

that can be readily lifted and fitted into position by one man. The body revolves on a bush which is attached to the end of the crank pin by means of a set screw. The bush is of steel, and is bored to suit the diameter of the crank pin to be trued. A screwed sleeve carrying the whole of the machine revolves on a large ball bearing fitted to the bush, additional support being obtained from a phosphor bronze bush. The ball bearing fitted in the main body not only ensures easy running but prevents any binding action when the machine is in operation.

The feeds to the truing tool and grinding wheel are reversible and automatic, and are obtained from a double cam operating two ratchets and pawls. When the turning tool or the grinding wheel is in operation, the grinding wheel or turning tool respectively is moved along its barrel until it is out of gear. In both cases radial feed is applied by hand.

The machine can be driven either by hand, by a rope from an overhead shaft, by an electric motor, or by pneumatic power. If an electric drive is employed the motor is placed on the floor and is connected to the machine through a flexible shaft, a worm, and a worm wheel. With a pneumatic drive the compressed air motor is directly connected to the machine through a worm and a worm wheel, which replaces the grooved pulley, shown in our engravings on the end of the body casting.

The device, we are informed, weighs complete about 1¼ cwt., and in its drive absorbs 1½ horse-power. It can deal with crank pins from 2in. to 6in. in diameter and up to 9½in. in length.

South African Engineering Notes.

Wankie Colliery Expansion.

The equipment of the Wankie Colliery in Southern Rhodesia is being reorganised, and the programme of plant reconstruction and expansion will entail an expenditure of approximately £350,000. The colliery has been supplying 14,000 tons of coke per month to the Union Minière copper mine, in the Belgian Congo, and in anticipation of enhanced demand the company recently decided to increase the coke-producing capacity of the plant to 17,000 tons per month. Thirty-seven new beehive ovens have recently been erected and forty new coke ovens of retort type are being installed. When they are completed, the colliery will possess 180 retort and 37 beehive, making a total of 217 coke ovens, which will constitute the largest coking plant in South Africa. In addition to the increased coking plant, a new washery of 150 tons per month capacity is being installed at the old —No. 1—colliery, and a very considerable portion of the plant is being reorganised. The new washery is being installed by the Manchester firm of Simon Carves, Ltd. New power plant is being installed at the old colliery, where the generating capacity will be increased to 7500 kilowatts during the next three years. The Wankie Company has also in hand the opening up of an entirely new colliery, situated at a distance of about 4 miles to the north-west of the existing No. 1 pit. This new, or No. 2, colliery is to be equipped with screening, picking, conveying, elevating and breaking plant, and also with a British Baum washery, which will have an initial output capacity of 1000 tons per day with provision for progress and expansion up to 5000 tons per diem. An incline with a dip of one in eight has been carried down into the coal seam, which at the No. 2 colliery is 25ft. thick, the quality of the coal in this area of the company's concession being, if anything, superior to that which has rightly made Wankie famous through outputs from its old or No. 1 mine. The new pit is situated at a point where there is ample room for expansion of equipment up to almost any size, and with its old colliery reorganised and a brand new pit in commission, Wankie will assuredly become an even more important factor in industry in Rhodesia and the Congo than it has hitherto been.

Railway Construction.

Of the twenty-three lines authorised by the 1922 programme of railway construction in the Union, only one remains to be completed, viz., that from George to Knysna, or 42 miles out of over 1000 miles. The earthworks on the remaining line are about completed, and 6¾ miles of rails had been laid up to the end of September. The lines authorised in 1924 and 1926 have a total length of close to 1000 miles. Nine of them, aggregating 400 miles, have been commenced, and good progress is being made. Of the Matubatuba-Swaziland border line, 95 miles in length, the whole of the earthworks had been completed by the middle of November, and 85 miles of rails had been laid and ballasted. Public traffic is being conveyed to mile 81 under ordinary branch line conditions.

Improved Mining Methods.

In the annual report dealing with the operations of the New Modderfontein gold mine on the Witwatersrand during the financial year 1925–26, it is stated that the net profit for the year amounted to £2,037,575, and thus for the third year in succession a record has been set up in this respect. Dividends amounting to 110 per cent. were paid during the year. The average tonnage crushed was 132,000 tons per month. The excellent development results during the year are in a very great measure due to the increasing efforts to improve mining methods. There has been a marked improvement in the drill steel available for use underground, which, at the New Modder, has now reached a high standard of perfection. The great and greater demands made upon the steel by the ever-increasing efficiency of the rock drills have been fully met. Much attention has been paid to the accurate gauging of bits and shanks, and special furnaces have been installed to ensure correct heat treatment. The marked progress achieved in these directions has resulted in the reduction of the number of steels, required to drill a hole, from three to two and from four to three in stoping and development work respectively. The advances made are clearly reflected in the striking increase in output per machine shift. In development, the footage advanced per machine shift during the year 1925–26 shows an increase of 33·6 per cent. The recent improvement in stoping efficiency is equally marked, the fathoms broken per machine shift for the month of June, 1924, 1925 and 1926 being 1·50, 2·96 and 3·37 respectively. Explosives efficiency has also shared in the general progress, the figures for the same three years showing a decrease in the pounds of nitroglycerine consumed per fathom broken from 7·7 to 5·3 and 4·7 respectively.

Lightning Causes Mine Fire.

During a heavy thunderstorm over a part of the Rand on November 15th, lightning struck the screening plant at the Largo Colliery, 7 miles from the town of Springs. The whole of the picking, crushing and screening plant, valued at £10,000, was destroyed, but the firemen saved the wooden headgear of the main shaft adjoining. Eight valuable electric motors were reduced to scrap iron.

THE Ministry of Transport has, according to the *Road-maker*, promised to encourage the use of less noisy road drills than the pneumatic type now used, provided an efficient kind can be devised.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Conditions.

In the heavy industries of the Midlands and Staffordshire the gradual development to something approaching normal activity is proceeding favourably, but it cannot be said, on the basis of actual business coming through, that there is any sign of a trade boom. Real recovery of industry is being retarded by high prices of fuel and raw material, and it is thought that unless the situation becomes clearer very desirable export business will be lost. On 'Change in Birmingham this week transactions in iron and steel were again confined to urgent needs. Both buyers and sellers seemed to regard it as safer to await developments than to make any attempt to force the pace till dislocations left by the coal stoppage have been corrected by the free play of supply and demand. The general opinion is that big business is in the offing, but is being held back until consumers satisfy themselves on the price question. The price situation is no clearer than it was a week ago. Fuel values continue to rule high, and producers of iron and steel accordingly must ask increased prices for their products. There has been little if any price changes on the week.

Manufactured Iron.

Staffordshire makers of finished iron are well employed. Their activity does not denote any great inrush of new orders, the fact being that a large proportion of the output is being applied to the clearing off of old commitments. The makers of marked bars, which continue to be quoted at £14 10s. per ton, are, however, experiencing an improved demand for the best classes of engineering work. Special iron for the chain and cable trade is also in request. This is a new demand, and is attributed to some activity in shipbuilding. Unmarked bars of Crown quality are generally quoted at from £12 10s. to £13, though a few transactions have taken place at below that figure in cases in which makers have been in competition with Lancashire houses offering supplies at £12 5s. The nut and bolt trade, which is better employed, is still, in the main, using imported bars, but British qualities are now on offer at from £11. Belgian No. 3 bars are quoted at £6 10s.

Steel.

Midland steelworks are busy executing orders booked months ago, and consumers' more urgent needs are now being supplied. The state of the order books promises activity for some months, and prices are not likely to show any signs of weakening until makers begin to seek for new business. Constructional engineers are meeting with a fair amount of inquiries for extensions of plant, &c., but definite business is being held over until prices recede further. Fairly good deliveries of English steel are coming to hand, and the foreign material which is still arriving is mostly in satisfaction of earlier bookings. Re-rollers are busy, but the orders booked during the past fortnight are substantially less than of late. The question of prices is still too indefinite for industrialists to launch out. Angles and joists remain at £7 17s. 6d. to £8, with tees 20s. more. Ship, bridge and tank plates are quoted £8 17s. 6d. to £9 2s. 6d.; boiler plates, £11 10s. Small steel bars range from £8 15s. to £9; while for mild steel billets for future delivery £7 to £7 5s. is asked. Staffordshire hoop makers have decided to reduce the price by 10s., this being half the amount of the advance declared when the conflict in the coalfields was running its course, and brings the selling figure to £11 at works. In their anxiety for business continental makers have reduced most of their material, billets being offered at £5 17s. 6d. Sheet bars are £6 2s. 6d., and one contract is said to have been arranged at as low as £5 17s. 6d. Steel bars are quoted at £6 10s.

Galvanised Sheets.

The demand for galvanised sheets has fallen off somewhat though inquiries from overseas continue to be received in fair volume, and many of them, it is hoped, will eventually materialise. The home trade in galvanised sheets is naturally quiet at this period of the year, and the price of £16 for 24-gauge corrugated remains unaltered.

Steel Scrap.

The demand for steel scrap has fallen off to some extent, and prices show weakness. Business has been done this week at about £3 7s. 6d. Some merchants ask as much as £3 10s., but it is believed that no scrap has actually been sold at this figure.

Pig Iron.

Midland pig irons are coming through in very small quantities from the furnaces, deliveries being mainly on old contracts. Prices are on recent levels, Northamptonshire foundry being £4 to £4 2s. 6d.; Derbyshire, £4 5s.; and Staffordshire, £4 7s. 6d., all for February delivery. For the first time since the stoppage a quotation was available this week for Lincolnshire iron at £4. At these prices makers are not booking much new business, although they are anxious to sell. Most authorities consider that reductions are bound to come when the normal British output is reached. Smelters still hold that fuel prices should come down to pre-strike levels at any rate, and as coke is still scarce and dear they are chary about bringing more furnaces into blast. The fuel position is to a great extent responsible for keeping up pig iron prices. Furnace owners naturally want to do as much business as they can at present rates, but the failure to arrive at terms agreeable both to producer and consumer alike is postponing the much looked-for revival of the industry. It is understood that heavy contracts are pending, but in the present uncertain state of the market they are being held over in anticipation that prices will fall. One thing appears certain, until there are further price adjustments in pig iron there will be very little contracting forward. The advance in railway rates will add appreciably to smelters' costs from the beginning of next month. Some Midland furnacemen estimate the extra burden at half-a-crown a ton before the iron is put on rail, but its incidence will vary with the distances which the raw materials and fuel have to be carried. Those furnaces which were blown in early after the end of the coal dispute have sold a moderately good tonnage over the first three months, and old contracts will claim the balance. More Midland furnaces are going in. Deliveries of continental iron are coming through on agreements made during the stoppage, a good deal of French pig iron having been ordered while the British blast-furnaces were out of action. Doubt was then expressed as to the wisdom of arranging contracts so far ahead, and it was hoped that by January native supplies would have been sufficient to meet the needs of consumers. The slowness of the output, however, together with the fact that modern steelworks are equipped to deal with big tonnages and absorb all the raw material they can get, appears to have justified the purchase of continental iron.

Fuel.

Fuel prices, which have given way only tardily after the first fall from the peak rates, are embarrassing many Midland manufacturers, while in the iron and steel trades they are acting as a serious deterrent to business. Very few fuel contracts have been made by local industrialists, who refuse to commit themselves forward at the prices now demanded. Consumers contend that coal and coke should be obtainable now at the prices they were paying before the stoppage. The instances in which it has been possible to renew contracts on these terms are few; hence consumers have bought only what will suffice for their immediate needs. This is a precarious situation for industry, inasmuch as stocks generally are, of course, very much lower than normal. The coke stringency persists. It does not appear that ovens are being brought back into commission any faster than the blast-furnaces, which depend upon them for their fuel, and current prices remain so high that smelters require much more for their pig iron than they were getting in April last.

Foundry Trade Outlook.

The position in and the prospects for the Midland foundry trade are, there can be no doubt, exceedingly encouraging. Mr. V. C. Faulkner, president of the Institute of British Foundrymen, at the annual dinner of the Birmingham, Coventry and West Midlands Branch of the Institute, held at the Engineers' Club, Birmingham, on Saturday evening last, expressed the opinion that the present year was going to be the best for trade that had been experienced for six years past. People who had had to put out furnaces owing to the recent strike were now putting in more furnaces than before. The orders received in the last three months by one large foundry, he was in a position to state, were the largest in the history of the firm. It was expected that by May next they would be in the thick of the boom. He asserted that the list of contracts for foundry work which would be printed the following week was the longest, largest and heaviest that he had seen in the last six years. There was one disturbing factor, however, in trade prospects, and that was the increase in railway rates. The intrinsic value of their output as foundrymen was low in proportion to its bulk, and it was obvious that they were going to suffer exceptionally.

Birmingham Exports to U.S.A.

Although exports from the Birmingham district to the United States of America during the last quarter of the past year continued to shrink, it is pleasing to be able to record that to a large extent the falling off was attributable to changed marketing conditions in the artificial silk trade. True, metal manufactures decreased from 349,732 dollars to 122,447 dollars, needles from 203,786 dollars to 192,436 dollars; leather and manufactures thereof from 622,996 dollars to 526,296 dollars; but other manufactures afforded some compensation. Iron and steel products advanced from 108,810 dollars to 126,275 dollars; brassware from 73,254 dollars to 96,722 dollars; steel sashes from 62,753 dollars to 91,362 dollars; and fishing tackle from 53,032 dollars to 56,839 dollars. The total value of the trade was 1,754,670 dollars, against 2,819,694 dollars.

Unemployment.

Unemployment in the Midlands area continues to decrease, the re-absorption of labour into industry in this district being more rapid than in many other industrial areas. Following the substantial decrease of 14,252 last week, the latest return records a further drop of 9484. It is interesting just at this time when trade is on the mend to note how the various large centres in the Midlands stand regarding the numbers out of work. In the Birmingham area there are now on the live register 36,928; Coventry, 2648; Bilston, 2982; Cradley Heath, 3280; Dudley, 3429; Leicester, 5534; Northampton, 2262; Nottingham, 8694; Oldbury, 1516; Redditch, 1173; Smethwick, 4010; Stoke-on-Trent area, 15,495; Stourbridge and Brierley Hill, 2889; Tipton, 2031; Walsall, 5331; Wednesbury, 2825; West Bromwich, 3366; Wolverhampton, 6037; and Worcester, 1634. Of the total, 116,650 are men, 3353 boys, 42,579 women, and 5402 girls.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Electrical Engineering's Active Year.

THE experience of the electrical engineering industry during the past year receives prominent mention in the annual report of the Engineering and Metals Section of the Manchester Chamber of Commerce, of which Sir B. Longbottom has been re-elected chairman, Mr. L. F. Massey vice-chairman, and Mr. H. Allcock honorary secretary. Discussing the causes of what is described as the electrical industry's "record year," both at home and abroad, in which all branches of production, with the exception of the industrial motor section, participated, the principal one so far as the home demand is concerned is ascribed to the erection of the new super-power stations, in preparation for the national power scheme. Compared with 1925 export business in electrical plant and machinery is estimated to have increased by 22 per cent. Discussing the industrial motor section, the report states that this is still suffering from the effects of the coal stoppage, and that confidence in the future will have to be firmly established before renewals of plant and industrial extensions will be reflected in an increased demand. As to the general engineering trades, it is pointed out that, granted settled conditions in the staple industries, there should be a steady and definite improvement.

The Steel-frame Building.

Appropriate to the occasion was the speech of Mr. J. M. Macfarlane, President of the Institute of Builders, at the annual dinner of the Lancashire and Cheshire Branch of the Institution of Structural Engineers. Structural engineers, he said, with their steel-frame buildings had accomplished something comparable with the application of power to the trade of the hand-loom weaver. They had given buildings a greater stability whilst reducing the substance of the structure, and had thereby greatly increased the possibilities of light and ventilation, as well as floor space; at the same time they had very considerably increased the productivity of city land by making it possible to erect a ten-storey building where before only three had grown, and one of fifteen storeys where there had only been five. Mr. Macfarlane, however, expressed the view that there were further worlds to conquer if structural engineering was to perform all the tasks expected of it. They were still awaiting the production of some form of rustless steel economically suited for constructional work, and a waterproof Portland cement. With these two mighty forces in their hands, their future would be beyond imagination.

Economy in Water Supply.

The huge saving that had been effected in the cost of laying the fourth pipe line from Thirlmere to Manchester was indicated in a paper by Mr. J. P. Hallam before the Manchester Branch of the Institution of Civil Engineers. When the project was under discussion, Mr. L. Holme Lewis, the Manchester waterworks engineer, put forward a scheme for terminating the new fourth pipe at a point where, by an artificial increase of the head, the existing three pipe lines could thenceforward be made to convey the quantity brought to that point by the four pipe lines. The installation of booster pumps at Lostock, near Bolton, is the essence of Mr. Lewis' scheme, and, up to the present time, only one of the pipe lines has been so fitted. It is estimated that the entire scheme when completed, will result in a saving of £700,000, as the laying of 6 miles of 50in. and 23 miles of 40in. main will be obviated. The cost of laying large water pipes, according to Mr. Hallam, has increased by approximately 100 per cent. since 1914, the rise in the rate of interest on loans being about 50 per cent.

Carrying Tractors to Market.

The first visit to Manchester docks of the Tractor, the appropriately named steamer of the Ford Motor Company, specially designed for the conveyance of tractors from the United States, occurred last week. The vessel has a capacity for 480 machines, which, fully assembled and without packing, are carried in the hold in four tiers, the tractors being held securely by means of a series of wooden rafters. Unloading is facilitated by means of two lifts, which bring up the machines from the hold to the deck, exit from the ship to the quay being by means of a gangway. For the return voyage to America, the framework in the hold is dismantled, and a general cargo taken on board. The Tractor has already made five trips to continental ports. The saving effected by the elimination of packing, assembling and reassembling costs is obvious.

Aeronautical Engineering.

A Manchester branch of the Institution of Aeronautical Engineers was inaugurated last week-end at a dinner which was attended by a number of people interested in the scientific and industrial side of aeronautics

Non-ferrous Metals.

The past week has witnessed a remarkable degree of weakness in all the non-ferrous metals, a movement which, in the case of tin, copper and spelter, was accentuated in the early days of this week. Buying of tin has only been of moderate extent, and, although up to the close of last week values had finished up steady after minor fluctuations, the loss since then has roughly amounted to £7 per ton. Under the influence of poor trade buying copper is also at a relatively much lower level than it was a week ago, and at the moment it looks as though a marked improvement in the demand is essential here before any upward movement of prices will be recorded. Poor inquiry, coupled with realising on a fairly extensive scale, and the prospects of fully adequate supplies, have left their mark on the spelter section, current values being about £2 10s. below what they were a week ago. Lead has been more or less neglected by buyers, and here again prices have suffered in consequence, the figures now quoted being much lower than they have been for some considerable time.

Iron.

So far there has been no indication on the part of pig iron producers of a move to reduce quotations, and prices now being asked on this market are substantially the same as they were last week. Users, however, seem clearly convinced that reductions will have to be made, judging from the cautious attitude they continue to adopt.

One hears of very little business of any importance being transacted, most of the orders that are being placed, in this centre at all events, being on a pronounced hand-to-mouth basis. As before, Derbyshire No. 3 foundry pig for delivery in the Manchester district is quoted at 92s. 6d. per ton. Middlesbrough brands are steady at about 97s. 6d., Scottish at 112s. 6d. and upwards, and West Coast hematite at 96s. 6d. per ton. A not unexpected "cut" in the prices of manufactured iron has been decided upon by the Lancashire Bar Iron Association, a reduction of 15s. per ton in the case of Crown bars and one of 10s. in second quality material bringing the respective quotations to £11 15s. and £10 15s. per ton, delivered in the Lancashire area. Demand at the moment is by no means extensive, but the drop may act as a stimulant.

Steel.

The feature of the steel market continues to be the weakness of continental products, and the consequent widening of the margin between the prices for these and the British quotations. In several instances, offers of imported steel are very little above what they were at the end of last April, and although there is not a great deal of buying going on, it is not improbable that buyers will begin to take more interest in offers from the Continent. Steel bars, including delivery to buyers' works in this area, are now down to £6 5s. per ton, sheet bars at £5 12s. 6d., joists at about £5 5s., ordinary plates at £7 2s. 6d. to £7 5s., and Siemens plates at £7 7s. 6d. per ton. Supplies of British steel are below requirements, and with a moderate inquiry still coming along, values remain quite firm, tank plates ranging from £8 17s. 6d. to £9 2s. 6d. per ton, joists at £7 17s. 6d. to £8 2s. 6d., boiler plates at about £11 10s., basic steel bars at £9 5s., and acid wire billets at £12 10s. per ton for special quality and £11 for ordinary. Galvanised sheets are much easier at £15 15s. per ton for 24 gauges, with thin sheets about 10s. per ton cheaper, demand being quiet.

Scrap.

Non-ferrous scrap metal prices are easier in sympathy with the new metals, and buyers are holding off as much as possible. Scrap lead is quoted at £26 to £27 per ton, zinc at £25 10s., clean light copper at £54, selected gun-metal at £51, brass rod turnings at £39, and heavy yellow brass at £44, for graded qualities and including delivery to users' works.

BARROW-IN-FURNESS.

Hematite.

It is possible that the quietness in the iron market at the moment is due to some extent to the increase in price which has followed the decision of the railway companies to increase rates. This increase naturally affects the cost of iron at both ends, for there are the higher rates on all raw material and also the higher rates of delivery. It is far too early to estimate the effect that the railway rates will have on the trade generally in this district, but one thing is very certain, the iron trade could have well done without this extra burden at the present time. In the meantime, the makers are busy on orders, which they hold and which will take some months to deal with, even with the sixteen furnaces now in blast. Apart from home trade business is developing, or has already developed, on American account, and the Continent is likely to become a customer, but not to any great extent. Many customers are taking the better qualities of iron, and trade in that respect is considerable. Ferro-manganese is assured of good business. Ingot moulds are in good demand.

Iron Ore.

The iron ore industry is fairly well employed, and likely to be, as it is hoped that business outside the district, especially with Scotland, will improve. Imports of foreign ore are developing now, and the arrivals will be regular.

Steel.

The mills at Barrow are engaged on rails, hoops, &c., and now the Workington mills are also engaged in turning out rails, sleepers, tires, &c. There are contracts held which will keep the mills going for some months, and further orders are expected now that definite dates for delivery can be fixed.

SHEFFIELD.

(From our own Correspondent.)

An Uncertain Outlook.

CONDITIONS in the heavy steel trade of this district continue very brisk, and production is on a larger scale than in the days immediately preceding the stoppage. The work in hand, however, relates largely to orders that had accumulated during the strike, or to urgent requirements that have come forward since. No weight of future work is being placed, and this fact is causing some anxiety with regard to trade after the next few months. It begins to appear that the spurt which followed the settlement is now exhausted, and many firms state that buying and inquiries show a falling off. That is probably due, in considerable measure, to the fact that prices remain high. Pig iron and steel material are still scarce and dear, and producers are not inclined to make more until coke is cheaper. At present, foundry pig is 84s. and 85s. at the furnaces, which is 15s. or 16s. in excess of the April prices, while blast-furnace coke at 18s. 6d. or 19s. shows a rise of about 4s. 6d. per ton. The influence of this is seen in the prices of steel. Local basic billets are now 10s. more than the pre-strike prices and acid billets 20s. more. A matter which is causing considerable perturbation among local manufacturers is the prospect of an increase in the municipal rates, to the extent of about 2s. in the pound, in April. Such an increase would be a serious burden upon industry, and would mean that many Sheffield firms would have to pay an additional sum running into four figures annually.

A Glance Round.

Coming to deal in detail with some of the branches of the steel trade, it is interesting to note that there are several good orders on hand for railway carriages. On the other hand, the wagon building departments are short of work. From the rolling mills comes the report that most of their customers are making only a slack demand for finished steel and many kinds of tools. Steel work of a special character is brisk, and there is an especially good demand from the motor and electrical industries. Large home and foreign contracts for heavy cast iron pipe are being executed in Derbyshire. The crucible steel trade has secured a substantial concession with regard to the price of the special coke required for melting the product. This price had been fixed at 45s. per ton, or 9s. more than was being paid before the dispute, but it has now been dropped by 4s.

Bristol Power Station Contract.

Bristol Corporation is about to construct a super-power electricity generating station at Portishead, on the Bristol Channel, about 7 miles from the city. Vickers Ltd. have received the main contract for the construction and initial equipment of the station, and its associated firm, Metropolitan-Vickers Electrical Company, Ltd., will supply the whole of the electrical plant, comprising the complete generating sets, transformers and switchgear, as sub-contractors.

Railway Work for the Argentine.

South American railway stock of a noteworthy character is just being completed by Craven's Railway Carriage and Wagon Company, Ltd., Darnall, Sheffield. The firm is giving the finishing touches to three bogie restaurant cars for the Central Argentine Railway, which are among the largest ever built in this country. Their overall length is 79ft. 4in., a size which will be the better appreciated when it is pointed out that the average English restaurant cars, large as they are, only measure 52ft. 6in. in length. The weight of each Argentine car is approximately 49 tons, as against an average of 28 tons for the cars running in this country.

New Bridge for Hull.

The Property Committee of the Hull Corporation has recommended that an immediate start be made with the construction of the new North Bridge and its approaches, and that the city engineer be requested to prepare specifications, bill of quantities, and detailed drawings, in order that tenders may be invited. The estimated cost of the scheme is £276,500, and the Ministry of Transport has agreed to make a grant from the Road Fund of £50,000, half of which is payable when the contract for the bridge is let, and the other half on completion of the works.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Trade Position.

WHILE the feeling generally in iron and steel trade circles in the North of England is still optimistic, some apprehension is felt at delay in carrying through large projects that are pending. Continental competition for substantial orders for which inquiries are circulating is keen, and some fear is felt that contracts expected to come to this district may be placed abroad. The fuel question is another matter which is causing some anxiety. The supplies of coal and coke are increasing, and prices promise to approach more nearly the views of consumers in the near future, but the prospect of regular adequate supplies of coke for the blast-furnaces is none too bright. If deliveries on a sufficient scale could be assured, more pig iron producing plant would speedily be put into operation. There are now forty-four blast-furnaces in operation, and others that are ready for re-kindling would be set going without delay but for the shortage of coke. Now that supplies of plates and sections are coming forward, operations at the shipyards are being considerably extended, and increased activity is reported at many engineering establishments.

Cleveland Iron Trade.

The continued scarcity of pig iron is creating serious difficulties for the consuming trades. While enlargement of production of pig iron in this district has been at a surprisingly rapid rate, the increase has not overtaken current needs. The fact is that the domestic needs of the steel firms have undergone an enormous expansion, and the result is that some of the biggest producers have not a ton of iron to spare for any of their customers. Other producers are selling limited quantities of pig iron, but they are quite unable to meet all the pressing demands made upon them and little attempt has been made to implement old contracts. Many consumers are thus very badly situated, and so urgent is their need that price has become almost a secondary consideration if only prompt deliveries can be obtained. Cleveland ironmasters are still quoting 6d. per ton extra for export, but it is purely a nominal figure, the fact being that there is no iron for export. In view of the necessity of recovering foreign markets this is unfortunate, but, after all, home needs must come first. For early delivery quotations are unchanged, No. 1 Cleveland foundry iron being 90s.; No. 3 G.M.B., 85s.; No. 4 foundry, 84s.; and No. 4 forge, 83s. per ton. Forward contracts up to the end of June can be fixed at 2s. 6d. per ton below the foregoing prices, and having regard to the prevailing scarcity, a number of consumers have placed business on those terms, taking the view that prices are not likely to fall any further.

Hematite Pig Iron.

The position in the East Coast hematite pig iron trade shows little material change. Supplies have not yet come on to the market, and the few small parcels that are obtainable from producers are quickly snapped up. Mixed numbers are quoted at 90s. per ton, and No. 1 quality at 90s. 6d.

Ironmaking Materials.

The foreign ore trade is beginning to show some signs of life. A number of cargoes have come forward this week, and further business is reported. Best Rubio ore is about 22s. per ton c.i.f. Tees. Supplies of coke are still inadequate to the needs of the trade, and 25s. per ton for good medium blast-furnace qualities is still an absolute minimum price.

Manufactured Iron and Steel.

There seems to be a more sluggish flow of new specifications to the steel works. All have big accumulations of orders, but new business is not coming along so quickly as was anticipated. That is not of serious moment so long as the works are busily employed, but the steel makers prefer to look well ahead, and would welcome new forward business. Prices are not appreciably altered, except that galvanised corrugated sheets are down to £16 per ton.

The Coal Trade.

Although the loading staithes at North-East Coast ports are very busy with coal shipments, yet the coal market is dull, and there is little forward inquiry. A good deal of business must have been transacted off the market in single cargoes to account for the present activity, even if the buying of larger quantities is still in abeyance in anticipation of lower prices. Requirements for prompt coal are evidently widespread. Thus the stemming for the next week or two is very full, and some collieries are having difficulty in fitting in additional turns. For next month trading is moving very slowly. Inquiries are circulating, but continental buyers counter-offer at much below merchants' quotations, and definite business matures slowly. Best Northumberland steams are obtainable at 17s. 6d., but for next month buyers' ideas range below 17s. Steam smalls, while not quite so plentiful, are still ample for all current requirements. Best are nominally steady at 11s., and second grades 10s. 6d. The coking trade continues brisk, and there is a heavy demand both for prompt and throughout the ensuing month. Up to 18s. is firmly asked for over a period, but, with spot supplies scarce, any lots available can command a few coppers advance. The gas coal trade for prompt remains quiet, and all descriptions offer freely, but producers fully expect to see a rapid rise in the demand for supplies from the London area, which, if developed, would tend to firm up prices. Sellers for this reason do not press on the market, and prices quoted are nominal. Best Durham qualities are 18s. 6d., and seconds 16s. 6d. Coke buyers are acting very cautiously, but the position for foundry cokes is a turn steadier. Although production is increasing, there is a good demand, which steadies prices at 24s. to 28s. for patent cokes. Gas coke is firm at 22s. to 22s. 6d.

SCOTLAND.

(From our own Correspondent.)

Slow Recovery.

WHILE there is a certain degree of optimism in trade circles generally the recovery from the blighting effects of the prolonged coal strike is somewhat slower than was anticipated. Producers and buyers alike have grown accustomed to the exercise of extreme caution, and, with few exceptions, neither are disposed to look beyond immediate requirements. The fact that in each year since the Armistice something in the nature of industrial strife or unrest has arisen to upset calculations, has no doubt fostered the strong feeling of uncertainty that abounds on all hands, and is evidently difficult to disperse. Some are confident that a new spirit will arise in industry which will dispel this feeling of distrust between employer and employed, and that the movement is already well afoot. At all events, there still seems to be a clinging to the "wait and see" policy, and progress is therefore necessarily retarded. The outlook in shipbuilding is brighter, and a recovery in that industry will have a far-reaching effect on the west of, if not throughout, Scotland. Fuel has been rapidly dropping to a more economic level, and many consumers were again considering the question of stocks, but the notice with regard to railway rates increases has come as a sort of damper at the moment. The outlook has not improved to any great extent, but in certain circles it is contended that progress may be slow but will be none the less sure.

Pig Iron.

Supplies of pig iron remain on a comparatively small scale. There are now some twenty furnaces in operation, but it is reported that makers find difficulty in securing iron of the desired quality and outputs are restricted in consequence. Foundry pig iron is particularly scarce. Prices, on the whole, are unchanged.

Wages in Pig Iron Trade.

As the average net selling price during October, November and December, 1926, has been certified as £4 11s. 11d. per ton, the wages of workmen will be increased by 9 per cent. on basis rates.

Steel and Iron.

Most of the steel works are again in operation, and in the course of a week or two may be almost fully employed. This, however, is mainly possible through the accumulation of old orders, new business being far from plentiful at the moment, owing, it is said, to the anticipation of cheaper prices in the near future. Shipbuilders are pressing for deliveries of material ordered months ago, but otherwise there is no particular activity.

Steel sheets show no falling off in demand, and prospects in this department are bright. Both black and galvanised descriptions are well placed for home and export delivery. Bar iron remains a rather quiet proposition, due in a measure to the high level of prices. Steel is being largely substituted, and the remelting departments are busy. Re-rolled steel bars are quoted in the region of £8 15s. per ton, compared with £11 15s. per ton for iron bars.

Coal.

General conditions in the coal trade have remained unaltered throughout the week, and business continues on restricted lines. Lanarkshire splints have good bookings on Italian account, and ells are a shade brisker, but other descriptions of West of Scotland fuel are rather poorly placed. Fifeshire steams are a shade busier, but the firmness of treble nuts is the only strong item in that district, which is hard hit by the scarcity of export orders. All classes of Lothians fuel are in need of fresh business. Collieries are getting fair outputs, and shipments against old contracts are comparatively good. Aggregate shipments amounted to 216,619 tons, against 218,400 tons in the preceding week, and 224,006 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THERE has not been a great deal of alteration in the steam coal trade outlook, as compared with a week ago. There is, of course, some speculation as to whether the troubles in the East will eventually have any effect upon the coal market. A few years ago the position was that the mere suggestion of any hostilities in almost any part of the world was quite sufficient to create a considerable amount of excitement and cause some movement in coal values; but times have altered. Oil fuel has made substantial inroads upon the market for coal. There is this much to be said, however, for the market, that prices have, on the whole, touched a lower level than a week ago and there is little doubt that in many instances collieries have reached the cost level, and will in many instances have to consider stopping operations if they cannot get their price. There have been many enforced stoppages at pits recently owing to the shortage of wagons, and this fact has naturally increased the working costs of various undertakings to an extent greater than would have been the case under normal circumstances. The outlook cannot by any means be described as promising as yet, but it is better. The last cargo of American coals to come to South Wales has arrived, and hopes are entertained that it will not be long before Welsh coals will have a fair market so far as their many European consumers are concerned, who for the time being are tied to contracts for American and German coals made immediately prior to the end of the stoppage in this country.

Contract Inquiries.

There are a few important inquiries on the market for coals, including one or two for supplies for South America, while the Norte Railways of Spain have asked for tenders for 30,000 tons and the Palestine Government wants prices early next month for 10,000 tons of good steam large coals for delivery at Haifa. In the case of the Egyptian State Railways, which asked for tenders for 100,000 metric tons of steam coals for delivery at Alexandria from February to April inclusive, news is now awaited as to the actual placing of the business. The tenders were opened on the 20th inst. at Cairo, and revealed that the lowest offer for Welsh coals was 31s. 11d. per ton, c.i.f. Alexandria, the next best price being 33s. c.i.f. Lower prices were put in for North Country and South African coals, but strong hopes are entertained that the business will come to this district. The general view is that the lowest tender of 31s. 11d. c.i.f. for the qualities stipulated by the railways, is rather on the risky side, from the point of view of those who put in the tender, as, basing upon current freight for Alexandria, this leaves only between 20s. to 21s. for the coals. As a rule, considerable notice is taken of the Egyptian State Railways' contract as affording a guide to other buyers, and this very low figure is not one calculated therefore to be of benefit to the coalowners, as the probability is that other foreign buyers will expect to be able to secure their coals on quite as good terms.

Coalfield Items.

The amount of irregular work in the coalfield is likely to cause unrest among the workmen, apart from other questions which are cropping up. The movement for the establishment of a fresh union in opposition to the South Wales Miners' Federation is one that will yet cause some bitterness between the rival camps. The new union is reported to have established already about fifty branches, and every week fresh sections are being formed. In different areas other questions are arousing some discontent. In the Rhondda there has lately been trouble. The whole of the collieries in the Cambrian combine, employing 10,000 miners, were stopped and the men demonstrated their protests. Their complaint is that they have grievances in respect to the reinstatement of workmen, and that the management has committed breaches of custom in other matters. As the result of a huge mass meeting the men have decided to continue to come out on strike every Monday until their grievances are remedied. This is a very irritating way of securing redress.

Export Trade Committee.

As the result of a conference at Cardiff last week, a committee, to be called the South Wales Coal Shipment Advisory Committee, is to be formed, and will comprise representatives of the coalowners, exporters, shipowners, shipbrokers and the Great Western Railway Company. This should be a very useful body for dealing with all questions which arise from time to time affecting the export trade. This Committee will meet once a month, or more often if the circumstances require it. By its means a useful interchange of views should be secured and the interests of all parties should be promoted.

Steel Trade.

The South Wales Siemens steel trade ascertainment for the past three months, which forms the basis of the wages sliding scale in the steel bar and tin-plate industry puts the average price of tin-plate bars at £6 12s., equivalent to 15 per cent. on the sliding scale. This is a slight decrease on the previous ascertainment, and will govern the wages from February 7th to April 30th inclusive.

Ebbw Vale Steelworks.

A welcome resumption of operations has taken place at the Ebbw Vale Company's works. Three furnaces were relighted last week-end, and two others are being prepared for blowing-in. When all five are operating there will be employment for about 3000 men.

Current Business.

The steam coal market has been extremely uneven. Most collieries have of late been only too ready to make concessions to those buyers who have been able to take quick delivery of coals, and thus enable the collieries to obtain empties and so continue working at the pits. Tonnage has not been any too plentiful also, and towards the end of last week there were many idle berths at the various docks. This week the conditions opened better, there being on Monday about twenty steamers waiting to get into berth, but this number will soon be worked off, and unless there is considerably more chartering than has been the case of late, the position of many collieries must be a rather anxious one from day to day. The top price for Admiralty large is 25s., and doubtless one or two undertakings will be ready to take 6d. to 1s. less than this for the best quality, provided early shipment can be arranged. Small coals in some instances are rather steadier, owing to the reduced output consequent upon the number of colliery stoppages. The price of superior grades is about 14s. 6d. to 15s. 6d. Coke, patent fuel and pitwood are all rather easier. It is reported that the British Admiralty has asked collieries for prices for a supplementary quantity of about 50,000 tons of steam coals.

The Institution of Civil Engineers.

OCTOBER EXAMINATIONS, 1926: PASS LIST.

(Subject to confirmation by the Council.)

Preliminary (73).—L. R. J. Absolon, W. B. Acton, R. A. H. Allen, G. C. Archer, J. C. Ballantine, O. D. Bell, T. B. Birchenough, A. H. Blow, R. G. Brickell, J. H. Burke, G. F. Clifford, H. H. Collette, J. R. Concher, N. Cook, K. E. Cotton, C. le B. Daman, E. Dixon, R. S. Drake, R. Elliott, N. Ellis, T. L. Farnes, H. R. Farrington, J. L. Fraser, R. E. Fuhr, A. R. Graham, A. Grant, R. G. Griffin, J. F. Griffiths, B. W. Hadfield, J. G. Hay, G. S. Hill, G. B. Hooker, D. R. Hunt, R. Inglis, J. E. Irvine, S. K. M. Iyer, V. Johnson, K. F. Jones, W. L. Jones, M. W. Lashmar, P. W. Loveday, J. B. Lund, T. L. Maccabe, N. A. L. MacDonald, G. H. McKenzie, J. C. Martin, S. D. Mitchell, P. R. Nath, W. G. Neat, C. J. Norris, W. L. Osborne, O. D. O'Sullivan, D. J. Peacock, W. H. Pink, J. W. Pope, K. A. Pope, W. G. Ramsay, H. R. Reid, H. A. Robinson, C. W. Sass, H. S. Southern, H. V. Steggles, R. Stent, B. W. Sutherns, D. I. Todman, L. G. Tucker, G. M. Vibart, G. E. Walker, H. Wallhouse, E. N. Ward, W. F. Wegener, A. K. Wilson, F. L. Wright.

Associate Membership (269).—*Whole Examination (Sections A, B and C)* (12).—N. K. Agrawal, W. C. Andrews, C. S. Douglas, W. M. Fisher, R. A. Haworth, R. Johnson, G. H. Kempton, F. J. Lancaster, R. McIntyre, N. T. Patel, R. Spence, G. D. Turnbull.

Sections A and B only (22).—C. E. K. Alcock, P. Banerjee, A. G. Boulton, A. J. Conacher, J. Dossor, L. A. Drain, P. B. Fasham, J. N. Fliteroft, C. W. Fraser, E. J. Garlick, G. L. Goulden, J. Izatt, I. McL. Malcolm, A. J. McD. Miller, H. Miller, T. Moorhouse, H. V. Phillips, J. A. Reynolds, W. T. Rondel, G. T. Starling, R. F. Stocks, J. E. Toop.

Sections A and C only (3).—E. G. Dale, C. S. Jackson, H. P. Sadler.

Sections B and C only (20).—F. W. Adie, A. F. Allen, J. H. Barton, W. H. French, F. L. Harwood, W. Hood, N. H. Hunt, G. S. Lindsay, J. Matthews, N. L. Paterson, T. H. Prince, A. A. Ragg, W. D. G. Rees, J. MacM. Riddet, P. H. Selbie, F. A. Shorter, R. G. Slyfield, W. Struthers, C. E. Whitaker, L. McI. Winchester.

Section A only (58).—W. Booth, C. V. Brown, J. Campbell, G. A. Cessford, B. N. Chatterjee, W. C. Clarke, H. M. Colman, R. B. Craig, R. M. Crichton, D. W. Currie, E. R. Davies, G. Downing, W. G. Dunstan, H. H. Evans, J. W. S. Fawcett, T. D. Hackney, H. B. Hall, H. L. Hammond, L. Hammond, E. R. Harris, A. A. Heath, F. Hewson, J. V. Jackson, J. E. Johnson, J. A. Johnston, J. R. Kanga, C. L. Kenmir, S. A. Lambert, M. H. Limb, L. A. Lincoln, W. G. McCarthy, D. W. McGregor, W. McIntyre, G. H. Marwood, L. L. Meadowcroft, J. C. Morris, A. G. Naldrett, T. M. Niven, D. M. O'Neale, J. L. Parkinson, B.Sc. (Edin.), F. W. Petre, R. P. Radcliffe, W. E. Roberts, E. L. Rushbrooke, R. E. Sadler, W. J. Scott, J. M. Simpson, D. G. Skitt, C. H. Smith, H. Snape, R. O. Tomkins, P. A. Turner, J. H. Walker, W. R. White, C. V. Williams, N. S. Williams, F. L. Wooldridge, W. F. Young.

Section B only (37).—A. Adlington, E. B. Allinson, W. G. Beeson, N. R. Carter, J. N. Deason, J. A. L. Denison, T. Donkin, G. J. Ellis, H. M. Everett, G. A. M. Gentery, R. A. Harrison, N. B. Henderson, F. F. Hixson, D. Holdsworth, E. Hoyte, S. Juleff, M.C., J. McE. King, C. C. Knowles, W. Livingston, O. C. Llewellyn-Jones, C. P. Lowe, G. H. F. Lutter, E. G. McLeod, J. MacNiven, J. D. Malcolm, H. Milne, H. F. Noyce, F. C. T. Nutter, W. T. P. Perkins, L. W. Rogers, G. Slater, M. J. Wardle, C. E. Whitcombe, J. S. Whyte, J. W. Wilkinson, D. B. Wood, N. Worrall.

Section C only (117).—A. R. Adams, B.Sc. (Eng., Lond.), M. E. Adams, G. Allan, J. F. A. Baker, A. W. Ballantine, B.Sc. (Glas.), R. S. Bamber, B.Sc. (Manchester), N. Barnard, R. J. Bee, A. C. Beever, B.Sc. (Edin.), A. H. Bernard, B.Sc. (Eng., Lond.), H. Black, B.Sc. (Edin.), L. Bown, R. C. Bracken, B.Sc. (Durham), C. A. Bradley, B.Sc. (Manchester), C. D. C. Braine, B.Sc. (Birmingham), F. L. Bronstorph, B.Sc. (Bristol), G. S. Brown, J. Bryan, B.Eng. (Sheffield), M. G. Bucknall, W. E. J. Budgen, B.Sc. (Eng., Lond.), P. Burgoyne, L. Carnie, G. H. Causey, B.Sc. (Manchester), J. H. Christie, W. M. Clark, B.Sc. (Cape), J. K. Clinch, B.A. (Oxon), D. E. Coles, R. V. Collman, B.Sc. (Eng., Lond.), J. D. Darubala, R. F. Davis, B.Sc. (Eng., Lond.), J. C. Dickinson, B.E. (New Zealand), C. B. Eck, P. Eckersley, R. H. Edwards, I. Evans, W. B. Farrow, B.Sc. (Wales), H. M. Finlay, B.A. (Cantab), M. Giles, B.A. (Cantab), J. F. Gourlay, B.Sc. (Glas.), W. J. E. V. Grace, W. F. Gray, C. R. Grixoni, B.Sc. (Eng., Lond.), G. H. Hadden, C. Haddon, B.Sc. (Glas.), G. V. G. Hall, B.Sc. (Bristol), W. Hamilton, A. L. Handley, B.Sc. (Eng., Lond.), J. C. Hargreaves, B.Eng. (Sheffield), G. Hebson, G. Heseldin, B.Sc. (Leeds), C. W. Hewlett, B.Sc. (Eng., Lond.), C. Heyes, B.Sc. (Eng., Lond.), C. E. Hollinghurst, B.Eng. (Liverpool), T. Holt, B.Eng. (Liverpool), L. M. Howard, D. W. D. Hutcheson, E. Hutton, R. T. James, U. S. Jayaswal, B.Sc. (Birmingham), D. W. Jones, B.Sc. (Leeds), O. Kean, F. M. Kenworthy, B.E. (W. Australia), W. J. S. Key, C. R. Kinton, J. N. Kirkness, B.Sc. (Glas.), A. P. Lambert, B.Sc. (Eng., Lond.), J. P. Larkin, A. N. Lechler, B.Sc. (Edin.), J. E. Lewis, N. K. Littlejohn, J. Long, J. McAdam, P. M. B. McBain, F. J. McIntosh, B.Sc. (S. Africa), A. K. Mackereth, A. M. Maddox, B.A. (Oxon), H. H. Mardon, B.Sc. (Eng., Lond.), A. H. D. Markwick, B.Sc. (Manchester), W. L. D. Martyn, B.Sc. (Manchester), A. P. Mason, B.Sc. (Eng., Lond.), D. Melville, J. Miller, B.Sc. (Glas.), J. A. Ogden, B.Sc. (Manchester), A. L. Owen, R. R. Pratt, B.Sc. (Eng., Lond.), C. J. Pybus, B.Sc. (Eng., Lond.), J. L. Raeburn, C. S. P. Randel, B.A.I. (Dublin), M. A. Read, B.Sc. (Eng., Lond.), C. A. Risbridger, B.Sc. (Eng., Lond.), C. MacC. K. Robertson, B.Sc. (Cape), H. S. Roe, B.Sc. (Eng., Lond.), R. Rose, B.Eng. (Liverpool), H. Samuel, B.Eng. (Liverpool), D. A. N. Sandifer, B.Sc. (Eng., Lond.), J. I. A. Scribante, C. F. N. Seaman, J. H. F. Sharkie, B.A.I. (Dublin), S. W. Slight, B.Sc. (Bristol), H. S. Smith, B.Sc. (Eng., Lond.), J. Speedy, B.A.I. (Dublin), C. R. Stone, L. G. Taffs, B.Sc. (Eng., Lond.), H. R. Tasker, B.Sc. (Eng., Lond.), W. K. Taylor, B. N. Wallis, B.Sc. (Eng., Lond.), S. G. Wardley, B.Sc. (Eng., Lond.), F. J. Watkins, G. S. Wells, M.C., B.Sc. (Eng., Lond.), J. L. Wells, A. G. Wheeler, T. Willey, R. J. Williams, E. R. Wilson, B.E. (National), R. G. Wilson, T. C. Woods, M.C., B.Sc. (Victoria), H. Wolf.

LAUNCHES AND TRIAL TRIPS.

KENTON, cargo steamer; built by the Tyne Iron Shipbuilding Company, Ltd., to the order of Arthur Stott and Co., of Newcastle-upon-Tyne; dimensions, 355ft. by 50ft. by 26ft. 4in.; 6650 tons deadweight. Engines, triple-expansion, 25in., 41in., and 68in. by 45in. stroke; pressure 180 lb.; constructed by the North-Eastern Marine Engineering Company, Ltd.; trial trip, January 21st.

CONTRACTS.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has received from the Air Ministry an order for the supply of Mazda metal filament lamps.

UNITED WATER SOFTENERS, Ltd., of Aldwych House, London, W.C. 2, has received from the Great Southern Railway of Ireland an order to equip the main line depôts at Inchicore, Ballybrophy, Limerick and Cork with water-softening installations. The same firm has received from the Sudan Government Railways and the Great Indian Peninsular Railway orders for softening installations to operate on the Lasson-Hjort lime-soda system.

THE WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Ltd., has received from the Metropolitan-Vickers Electrical Company, Ltd., an additional order for 232 motor-driven air compressors, type DH-25, and 232 air-pressure governors, type ES-16, for motor coaches for the Southern Railway. The same company has also received, through its agents, Messrs. Taylor and Shaw, of Sheffield, an order from the Warwickshire Coal Company, Ltd., for equipment for the operation and control of air lock doors at the latter's empty and full-tub air locks.

A RECORD IN LONG SERVICE?—An interesting event took place at the works of J. and E. Hall, Ltd., of Dartford, on the evening of January 14th, when the directors entertained no less than 134 employees, all of whom had a record of over twenty-five years' service in the firm. Seventeen of them had over forty years' service to their credit. It is thought to be almost unique for a firm to have over 9 per cent. of the men in its employment with more than a quarter of a century's service behind them.

WADE'S TABLES.—Wade's Tables are well known to all who are interested in overhead transmission lines. They were published in 1906, but have been rendered obsolete by the new rules governing overhead construction which have been formulated by the Electricity Commissioners. As a result, Richard Wade, Sons and Co., Ltd., of Hull, were invited by many electrical engineers to get out new tables. The first tables were compiled by Mr. Christopher Wade, and were calculated from tests of wooden poles the bases of which were firmly held. The new tables, a copy of which has been sent us by the firm, are still based upon the original tests, but with the object of obtaining some knowledge of the practical strength, a number of additional trials of models and full-sized poles planted in the ground, just as they would be in actual overhead construction, have been made. These tables cover both high and low-tension work, and a new set dealing with the problem of the sag of wires has been added. In view of the anticipated development of electrical transmission under the Electricity Supply Act, these tables should be very welcome. They are forty-three in number, and some of them cover poles between 22ft. and 62ft. in height and of various diameters, whilst others deal with the conductors themselves, giving the sag in feet for specified conditions. An explanatory note introduces the tables.

THE ELECTRICITY (SUPPLY) ACT, 1926.—A report to the South-East Lancashire Advisory Board showing the general effect of the Act upon the various constituent authorities has been published. This report summarises and explains briefly in non-technical language the provisions of the Act so far as they relate to the various classes of authorised undertakers and other bodies likely to be effected, but it does not deal with the sections of the Act which relate to the financing and financial administration of the Board. The contents of the report include articles on selected stations, non-selected stations, bulk supply receivers, joint electricity authorities, power companies, companies other than power companies, local authority undertakers, railway companies, standardisation of frequency, compensation for deprivation of employment, delegation of powers to the Board, the Board as authorised undertaker, and authorised undertakers' additional powers. As an appendix a diagram is furnished showing the processes of preparation and adoption of the scheme. The authors of the report have done their work very satisfactorily, and we feel sure that those who read it will be able to form a much clearer general idea of the objects and scope of the Act than would be obtainable from a copy of the Act itself. The signatories to the report are Alderman W. T. Dagnall, chairman of the South-East Lancashire Electricity Advisory Board; Mr. W. J. H. Wood, chairman of the Engineering Advisory Committee; and Mr. A. H. Banks, clerk to the Board.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 10 0	—
No. 1 Foundry	4 15 0 to 5 0 0	—
No. 3 Foundry	4 12 6 to 4 15 0	—
N.E. COAST—		
Hematite Mixed Nos.	(e)4 10 0	4 10 0
No. 1	(e)4 11 0	4 11 0
Cleveland—		
No. 1	(e)4 10 0	4 10 6
Silicious Iron	(e)4 10 0	4 10 6
No. 3 G.M.B.	(e)4 5 0	4 5 6
No. 4 Foundry	(e)4 4 0	4 4 6
No. 4 Forge	(e)4 3 0	4 3 6
Mottled	(e)4 2 0	4 2 6
White	(e)4 2 0	4 2 6

(e) *January - February Delivery.*

MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	4 0 0	—
" " Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	4 0 0 to 4 2 6	
" Forge	3 14 0	—
(3) Derbyshire—		
No. 3 Foundry	4 5 0	—
Forge	4 0 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 5 0	—
No. 4 Forge	—	—
Basic	3 17 0 to 3 18 0	
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 17 6 (a); 5 0 6 (b); 5 4 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 15 0	11 10 0
Best	—	—
N.E. COAST—		
Common Bars	12 5 0	—
LANCS.—		
Crown Bars	11 15 0	—
Second Quality Bars	10 15 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	12 10 0	—
Best Bars	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	12 15 0	—
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	11 0 0 to 11 5 0	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	—
Ship Plates, ¾in. and up	8 7 6	7 0 0
Sections	7 17 6	6 5 0
Steel Sheets, under 3/16in. to ¼in.	12 10 0 to 13 10 0	
Sheets (Gal. Cor. 24 B.G.)	—	£16 5 0 to 17 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 17 6	—
Angles	8 12 6	—
Boiler Plates	12 10 0	—
Joists	8 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0†	—
Light Rails	8 15 0 to 9 0 0	
Billets	8 0 0 to 11 10 0†	
MANCHESTER—		
Bars (Round)	9 0 0	—
" (Small Round)	9 5 0	—
Hoops (Baling)	11 0 0	11 0 0
" (Soft Steel)	10 15 0	10 15 0
Plates	8 17 6 to 9 0 0	
" (Lancs. Boiler)	11 10 0	—
SHEFFIELD—		
Siemens Acid Billets	11 0 0	—
Bessemer Billets	11 0 0	—
Hard Basic	9 2 6	—
Intermediate Basic	8 12 6	—
Soft Basic	7 15 0 to 8 0 0	
Hoops	12 0 0	—
Soft Wire Rods	10 0 0	—
MIDLANDS—		
Small Rolled Bars	8 15 0 to 9 0 0	
Billets and Sheet Bars	7 0 0 to 7 5 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	16 0 0	—
Angles	7 17 6 to 8 0 0	
Joists	7 17 6 to 8 0 0	
Tees	9 0 0	—
Bridge and Tank Plates	8 17 6 to 9 2 6	
Boiler Plates	11 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/9 to 20/6
Block Tin (cash)	292 5 0
" (three months)	288 0 0
Copper (cash)	54 12 6
" (three months)	55 2 6
Spanish Lead (cash)	26 8 9
" (three months)	26 15 0
Spelter (cash)	28 17 6
" (three months)	28 17 6
MANCHESTER—	
Copper, Best Selected Ingots	61 10 0
" Electrolytic	62 12 6
" Strong Sheets	90 0 0
" Tubes (Basis Price) lb.	0 1 0¾
Brass Tubes (Basis Price) lb.	0 11¾
" Condenser lb.	0 1 2
Lead, English	28 2 6
" Foreign	27 0 0
Spelter	29 10 0
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
" " 6 p.c. to 8 p.c. "	£22 0 0	7/3
" " 8 p.c. to 10 p.c. "	£20 17 0	6/6
" " Specially Refined		
" " Max. 2 p.c. carbon	£36 2 6	11/6
" " " 1 p.c. "	£42 5 0	15/-
" " " 0·70 p.c. carbon	£54 0 0	17/6
" " " carbon free		1/5d. per lb.
Metallic Chromium		3/3 per lb.
Ferro Manganese (per ton)	£16 for home, £16 for export	
" Silicon, 45 p.c. to 50 p.c.	£11 7 6 per unit	scale 5/- per
" " 75 p.c.	£18 10 0 per unit	scale 6/- per
" Vanadium	14/6 per lb.	
" Molybdenum	5/1 per lb.	
" Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Cobalt	8/6 per lb.	

FUELS.

SCOTLAND.

(Prices not stable).

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	17/-
" " Ell	17/6
" " Splint	21/- to 22/6
" " Trebles	20/6
" " Doubles	18/6
" " Singles	17/3
AYRSHIRE—	
(f.o.b. Ports)—Steam	17/6
" " Jewel	19/-
" " Trebles	21/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	14/- to 16/-
Screened Navigation	23/-
Trebles	21/6 to 26/-
Doubles	18/- to 18/6
Singles	16/6 to 17/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	15/9
Secondary Steam	15/-
Trebles	22/-
Doubles	17/9
Singles	16/3

ENGLAND.

(8) N.W. COAST—	
Steams	28/-
Household	*No quotation.*
Coke	32/6
NORTHUMBERLAND—	
Best Steams	17/6 to 18/-
Second Steams	16/- to 16/6
Steam Smalls	12/-
Unscreened	16/- to 17/-
Household	23/- to 30/-
DURHAM—	
Best Gas	18/-
Second	16/- to 16/6
Household	23/- to 30/-
Foundry Coke	27/6
SHEFFIELD—	Inland.
Best Hand-picked Branch	40/- —
Best Selected House Coal	34/- to 35/- —
Barnsley Best Silkstone	30/- to 32/- —
Derbyshire Best Brights	30/- to 32/- —
" " House	28/- to 30/- —
" " Large Nuts	26/- to 28/- —
" " Small	18/- to 21/- —
Yorkshire Hards	19/- to 21/- —
Derbyshire Hards	19/- to 21/- —
Rough Slacks	12/- to 12/6 —
Nutty Slacks	8/6 to 9/6 —
Smalls	3/- to 6/- —
Blast-furnace Coke (Inland)	20/- to 25/- at ovens.*
" " (Export)	f.o.b. 26/- to 27/-

CARDIFF— (9) SOUTH WALES.

Steam Coals :	
Best Smokeless Large	23/6 to 24/6
Second " "	22/9 to 23/6
Best Dry Large	22/6 to 23/-
Ordinary Dry Large	21/6 to 22/-
Best Black Vein Large	22/6 to 23/-
Western Valley Large	22/6 to 23/-
Best Eastern Valley Large	22/- to 22/6
Ordinary " "	21/6 to 22/-
Best Steam Smalls	14/6 to 15/6
Ordinary "	11/- to 14/-
Washed Nuts	22/6 to 29/-
No. 3 Rhondda Large	29/- to 29.6
" " Smalls	18/- to 19/-
No. 2 " Large	23/- to 24/-
" " Through	18/6 to 19.6
" " Smalls	14/- to 14 6
Foundry Coke (export)	40/- to 50/-
Furnace Coke (export)	30/- to 35/-
Patent Fuel	28/6 to 29/-
Pitwood (ex ship)	29/6 to 30/-
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	35/- to 40/-
Seconds	30/- to 35/-
Red Vein	27/6 to 30/-
Machine-made Cobbles	45/- to 50/-
Nuts	55/- to 60/-
Beans	45/- to 47·6
Peas	25/- to 27/6
Breaker Duff	9·6 to 10/-
Rubbly Culm	14/6 to 15/-
Steam Coals :	
Large	23/- to 24/-
Seconds	22/6 to 23/-
Smalls	10/- to 13,6
Cargo Through	19/- to 20/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b † Latest quotations available.

(a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. * Open market price. Special price for pig iron producers, 19/- per ton at ovens.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Situation.

THE weakness of the trade situation has further accentuated, and in view of the almost complete absence of buying there is nothing yet to warrant the optimism of those who believe that the crisis will be of short duration. The offering of steel at lower prices has failed to stimulate orders. There have been rumours of the early closing down of big works, but while such rumours may exaggerate the real state of affairs, there is no doubt that nearly all makers are working short time. Official returns show that the number of men unemployed in the metallurgical trades and in receipt of relief is about 39,000, or 10,000 more than in the preceding week. This is no indication of the total number of men out of work, most of whom are not yet eligible for the dole. Arrangements are being made to put works in hand to provide as much employment as possible. The only satisfactory feature is the placing by the Rail Union with French makers two-thirds of an order for 20,000 tons of rails for Finland, the remainder going to Belgium. It is expected that further orders for rails will be received shortly from the Congo.

Trade Returns.

The returns of foreign trade during 1926 were so entirely falsified by the fluctuations of currency values that their only interest lies in the effect of the appreciation of the franc during the last two months of the year. For the whole year the value of imports was returned as 59,514 million francs, an increase on the previous year of 15,419 million francs. The exports were estimated at 59,534 million francs, an augmentation of 13,779 million francs. In the latter total manufactured goods counted for 37,749 million francs, which was 8543 million francs more than in 1925. The improvement was due to the depreciation of the franc, for there was a diminution of nearly 2,000,000 tons in imports and an increase in exports amounting to about the same figure. During December there was a diminution in the value of manufactured goods imported as compared with November and a falling off in exports of both raw material and manufactured goods.

The Chambon Barrage.

Work has been started upon the construction of the Chambon barrage, which will create a lake on the Upper Romance at the junction of the departments of the Isère and the Hautes-Alpes. This work is being undertaken, with the aid of the State, by a private syndicate composed of owners of hydro-electric power stations on the Romance who utilise something like 100,000 horse-power. They find it necessary to provide a reserve of energy to compensate for the intermittent supplies from the Alps glaciers. At present their factories are frequently stopped through the failure of water supply both in winter and in summer, and it has long been evident that power stations cannot rely entirely upon water from the ice fields for a sufficiently regular head. The barrage, which closes a gorge, will be about 3400ft. above the sea level. The height of the dam will be 286ft. and its length at the top 925ft. Its thickness at the base will be 108ft., and it will be constructed of reinforced concrete. The artificial lake will have an area of 320 acres. It will cover the sites of three villages, Chambon, Dauphin and Parizet, and the national road will have to be diverted for a distance of about 2½ miles.

Hydraulic Works.

All the great hydraulic works, such as those on the Rhone and the Dordogne, have had to be postponed through the impossibility of raising the necessary capital. As financial undertakings they offer no inducement because too much time must elapse before there can be any return upon the capital, and even then the return is considered to be more or less problematical. Capitalists prefer to invest their money in power stations with heat plants which cost less, are more rapidly constructed and can be erected in centres where there is a demand for all the current that can be supplied. This failure to carry out the great national electrification scheme is regarded as a serious matter in view of the hopes that were based upon its realisation, and obviously nothing further can be done until the country's finances permit of the State bearing the greater part of the cost. Still, there is a good deal of activity in the construction of small hydro-electric installations by private companies for supplying energy to their own members. During the past six years no fewer than fifty-three concessions have been granted for the construction of small power stations with the aid of loans granted by the State. All of them are not put in hand, but nevertheless the aggregate total of the small power stations under construction or to be constructed is quite considerable.

Underground Paris.

The problem of dealing with the traffic in Paris is so serious that the only solution which seems likely to prevent a complete blocking up of the streets in the centre of the city is the construction of underground roadways. For some time a commission has been investigating the matter, and started by examining schemes presented by municipal engineers. A public competition was then opened, when twenty-two projects were received, but only seven of them were regarded as at all practical, and finally they were all rejected because it appeared impossible to carry them out without sacrificing pavements and demolishing houses. For these reasons it is found difficult to pass the Rue and Faubourg Montmartre under the main boulevards. Finally, it was decided to select some of the most practical features from the different reports and endeavour to amalgamate them into one scheme, while another public competition will be opened in the hope that some acceptable proposal will be forthcoming. The idea of constructing a moving platform under the boulevards has been definitely rejected since the experiments carried out a year ago with various systems showed that a platform offering complete security would be far too wide to be at all practicable.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

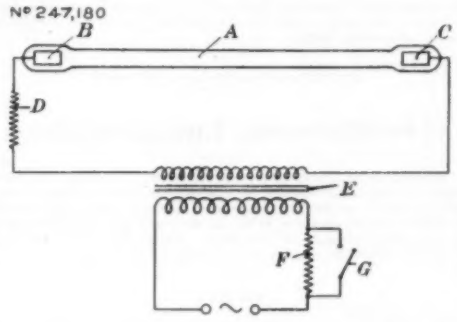
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

ELECTRICAL APPLIANCES.

247,180. January 29th, 1926.—IMPROVED PROCESS AND INSTALLATION FOR PRODUCING, SIMULTANEOUSLY OR SUCCESSIVELY, LIGHT OF DIFFERENT COLOURS BY MEANS OF A DISCHARGE TUBE HAVING POSITIVE COLUMN LIGHT, N. V. Philips' Gloeilampenfabrieken, of Emmasingel 6, Eindhoven, Netherlands.

This invention essentially consists in causing the current density within a discharge tube to vary with respect to time, the density being such that at the high current density the light of the rare gas or gases predominates, and at the low current density the light of the vapour or vapours predominates. A discharge tube consisting of a long glass tube A, filled with a rare gas and a vapour of suitable pressure and provided with



electrodes B and C, is connected in series with a steadying resistance D and with the secondary winding of a transformer E, the primary winding of which is connected to an alternating-current network. In the primary transformer circuit is a resistance F, which, by means of a switch G, can intermittently be short-circuited, for example, in a mechanical manner, the regular times of closing and interrupting being, for example, of the order of a second. The effect above-mentioned will then be produced by a suitable choice of the various electric magnitudes. If each time only part of the resistance F be short-circuited, the steadying resistance D may be omitted. The resistance F may also be omitted, the switch G then being placed in parallel with part of the resistance D.—*December 22nd*, 1926.

TELEGRAPHS AND TELEPHONES.

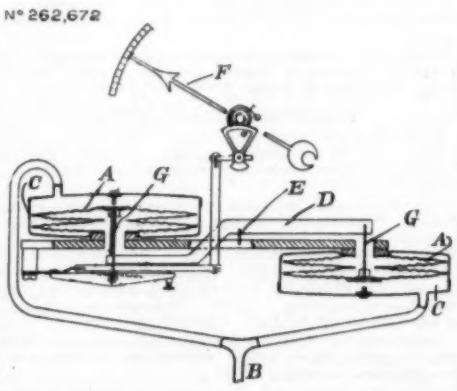
263,059. August 18th, 1925.—IMPROVEMENTS IN MAGNETIC MATERIALS, *Standard Telephones and Cables, Ltd., of Connaught House, Aldwych, London, W.C. 2.*

This invention relates to a magnetic material comprising two magnetic elements, nickel and iron, with the nickel in preponderance, to which is added a third magnetic element, viz., cobalt, the resulting material possessing high permeability and low hysteresis. The proportion of nickel which it is preferred to use is in the neighbourhood of 78½ per cent. of the whole material. The proportion of cobalt added is preferably at least 5 per cent. of the whole material. The invention also relates to a magnetic material, comprising nickel, iron and cobalt, with the nickel preponderating, the permeability of which has been increased by suitable heat treatment. The heat treatment preferred for the purpose of obtaining maximum permeability may be either of the following:—(*a*) The material is brought to a temperature of about 1100 deg. Cent., cooled slowly to a temperature near the magnetic transition temperature of the material, and then cooled rapidly at a predetermined rate, which is intermediate an annealing rate and a rate at which undue stresses and strains will be set up in the material. Alternatively, the material may be cooled down slowly from 1100 deg. Cent., and then reheated to the magnetic transition temperature, from which point the rapid cooling may take place as described above. The rapid cooling may take place at a rate of 9·5 deg. per second. (*b*) The material is heated to about 1100 deg. Cent. and then cooled slowly.—*December 16th*, 1926.

MEASURING AND TESTING INSTRUMENTS.

262,672. July 27th, 1926.—DIAL PRESSURE GAUGES, H. M. Negretti, P. E. Negretti, M. W. Zambra, and H. W. Ibbott, 38, Holborn-viaduct, London, E.C. 1.

It is not very easy to follow the significance of this invention;

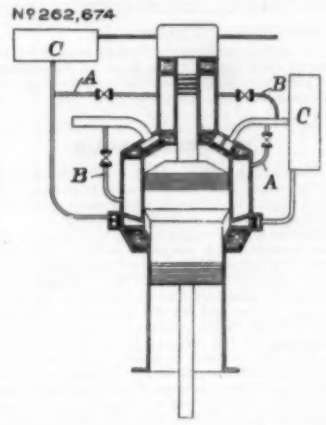


but it appears that one of the principal ideas is to use the diaphragm chambers A A in compression by subjecting them to the pressure to be measured, which is transmitted by the pipe B, in enclosed chambers C C. The movement of the two diaphragms is correlated by the lever D—which is carried by the spring fulcrum E and works in conjunction with the pins G—and is transmitted to the pointer F by the linkage and gearing shown.—*December 16th*, 1926.

PUMPING AND BLOWING MACHINERY.

262,674. August 7th, 1926.—AIR COMPRESSORS, G. and J. Weir, Holm Foundry, Cathcart, Glasgow, and J. Affleck.

This invention virtually amounts to the jacketing of the cylinders of an air compressor with air warmed by the process

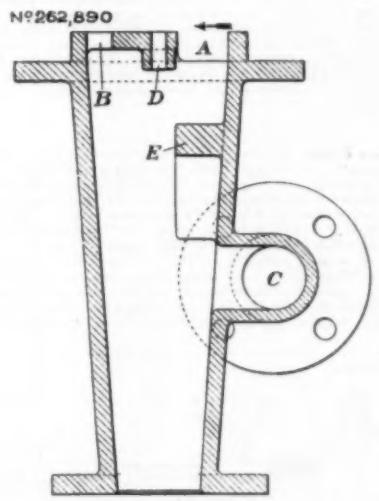


of compression and tapped off from the deliveries from the several stages to be returned to the suction branches after having served its purpose in the jackets. The illustration shows these tappings at A A and the returns at B B. C C are intercoolers.—*December 16th*, 1926.

MINING MACHINERY.

262,890. October 16th, 1925.—COAL-WASHING APPARATUS, Flow Coal Washery Company, Ltd., 22, Cooper-street, Manchester; A. Russell, The Firs, Loscoe, near Codnor, Derby; and S. Austin, 62, Tylney-road, Park, Sheffield.

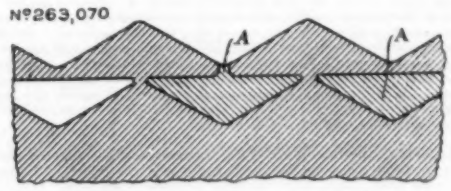
This apparatus is intended for use in connection with a launder, down which dirty coal is washed with the object of purifying it. Beneath the launder there is a series of pockets



one of which is shown in the illustration. As the mixed mass flows down the launder, in the direction shown by the arrow, the shale tends to fall out into the pocket by way of the opening A. Any coal which it may entrain is returned to the launder through the passage B by a current of water supplied at C. D is merely a poker hole for clearing purposes, while E is a baffle to distribute the classifying effect of the rising current of water.—*December 23rd*, 1926.

263,070. October 12th, 1926.—STONE CRUSHERS, P. Beechgaard, Dalby, Sweden.

In this specification the inventor comments on the difficulties experienced in maintaining a cutting edge on the jaws of rock breakers, and suggests that the trouble may be overcome by



casting the jaws with a plurality of superimposed cutting edges, as shown in the drawing. The consequent intervening spaces A A are to be filled with a friable material, which will be dissipated when the first set of edges is worn away.—*December 23rd*, 1926.

TRAMWAYS AND RAILWAYS.

263,032. June 7th, 1926.—MOVING PLATFORMS, F. Kruckenberg and C. Stedefeld, 1, Unter der Schanz, Heidelberg, Germany.

This is a most voluminous and verbose specification, but it seems that the essence of the idea is as follows:—A moving platform or never-stop railway is formed as a series of carriages,

narrow by comparison with their length. At the stations, where passengers board or alight, the carriages are folded together, and presented endways to the platforms. In the intervening journeys the carriages are extended, endways, and travel so much faster

than they do at the platforms as is represented by the ratio of their length to their width. The drawing reproduced gives an idea of the general principle, but the specification covers many details of the mechanism.—*December 23rd*, 1926.

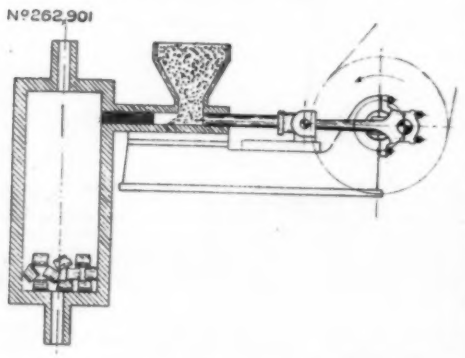
MISCELLANEOUS.

251,931. September 30th, 1925.—IMPROVEMENTS IN AND RELATING TO PAPER INSULATION FOR ELECTRIC CABLES AND THE LIKE. Felten and Guilleaume Carlswerk, Actien Gesellschaft, of Köln-Mülheim, Germany.

In high-tension cables and other parts of conductors carrying high-tension currents, it is desirable to build up the insulation by means of concentric layers of different dielectric constant, the layers having the highest dielectric constant lying directly on the conductor and the layers having a smaller dielectric constant lying further out for the purpose of obtaining a uniform drop of voltage in the insulation. According to the invention, use is made of the various layers of the insulation of a paper, the dielectric constant of which is increased by an increase of its contents in cellulose per unit of volume by rolling or pressing, and the pressed paper is treated with coating or impregnating materials of different dielectric constants in such a manner that an impregnating material, the dielectric constant of which is as high as possible, is used for the impregnation of the pressed layer of paper which lies directly on the conductor, whilst for the subsequent layers use is made of impregnating materials, the dielectric constants of which are gradually smaller. The pressure applied to the paper used is so high as to reduce its thickness as far down as 60 per cent. of its original thickness, its density being correspondingly increased, attaining a value of 0·90 and more. The greater the voltage the more desirable it is to effect the gradation of the dielectric constant. Thus, according to the invention, the result it is desired to attain may be further increased by the simultaneous use of two means for the gradation, the means consisting in using differently pressed papers, and the paper that has been pressed most is used directly next to the conductor, and is impregnated with a material which has the highest possible dielectric constant, while the paper layers that lie towards the outside are gradually graded with respect to pressure and impregnation. Use may be made as impregnating materials for the pressed paper of solutions of organic substances, such as artificial resins or phenol resins, which are not soluble in the usual impregnating substances. According to whether the corresponding paper lies nearer to or further away from the conductor, the solution is made stronger or weaker. After the solution is evaporated and the resin is converted by heat into the insoluble form, the papers thus treated are used for providing the layers of insulation and are then impregnated with the usual insulating substance.—*December 23rd*, 1926.

262,901. November 5th, 1925.—APPARATUS FOR FEEDING SOLIDS INTO OR REMOVING SOLIDS FROM VESSELS UNDER PRESSURE, *J. Y. Johnson*, 47, *Lincoln's Inn-fields, London*.

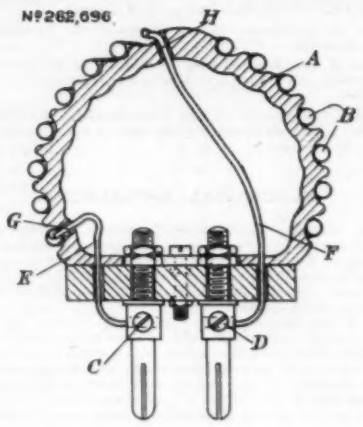
The patentee introduces this specification with the following words, beyond which it is hardly necessary to go:—This invention relates to a process and apparatus for feeding solids into or removing solids from vessels in which gases or liquids are maintained at a high pressure of 100 atmospheres or over. My foreign correspondents have found that solids can be introduced into such vessels without releasing the pressure and without the employment of valves or the equivalent, by forcing the solids in known manner through a tube or cylinder in communication



with the high-pressure vessel, but not provided with any closing device, by means of a piston or plunger capable of exerting sufficient pressure to produce a tight core or stopper, of the said solid body within the said tube or cylinder of sufficient length to resist the pressure within the vessel, and to effect a tight closure between the high-pressure vessel and the atmosphere. By the reciprocation of the said piston or plunger, additional amounts of the solids are pressed from any suitable source of supply into the said tube or cylinder, whereby the core or stopper constituted by the said solids is gradually moved forward, the foremost part of it falling down into the high-pressure vessel.—*December 23rd*, 1926.

262,696. September 29th, 1926.—IMPROVEMENTS IN OR RELATING TO ELECTRIC RESISTANCES FOR HEATING ELEMENTS OR THE LIKE. The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C. 2, and Alexander Kinnes and John Lambert Rycroft, both of Research Laboratories of the General Electric Company, Ltd., Wembley, Middlesex.

The object of this invention is to provide simple and effective means whereby an electric resistance may be strengthened in a region where a resistance of ordinary construction, owing to its liability to become overheated, or to the possibility of the resistance becoming unduly stressed, is particularly liable to become broken. In the drawing the insulating support A is furnished in the usual manner with a coiled wire resistance B. Normally, it is found that the ends of such a resistance are liable to fail, perhaps partly owing to oxidation of the terminals C and D, and consequent high contact resistance, or perhaps partly owing to the ends E and F of the resistance being brought through the interior of, and being surrounded by, the support A, and the resulting decrease of radiation from the parts contained within the support. As shown, the ends of the resistance wire from terminals C and D as far as the outside of holes G and H are formed of



increased cross section. The method of increasing the cross section of the wires in accordance with the invention is described.—*December 16th*, 1926.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF LOCOMOTIVE ENGINEERS: MANCHESTER CENTRE.—College of Technology, Sackville-street, Manchester. Discussion on "Mass Production as Applied to the Repairing of Locomotives," opened by Mr. S. Symes. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W 1. Paper, "The Design of High-tension Sub-stations," by Mr. C. E. Atkinson. 7.30 p.m.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Room 14, Temperance Institute, Keighley. Lecture, "Oil Engines," by Mr. J. McNish. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Literary and Philosophical Society's Lecture Theatre, Newcastle-upon-Tyne. Paper, "The Economy of Tank Testing of Ship Forms and Research in Ship Propulsion," by Mr. G. S. Baker. 6 p.m.

PHYSICAL SOCIETY.—Imperial College of Science, South Kensington, London, S.W. 7. Papers, "Electrical Polarisation in Selenium Cells and the Effects of Desiccation," by Professor A. O. Rankine and Mr. J. W. Avery; "Synchronous Alternating-current Motors and Mechanical Vibrating Systems Maintained by Thermionic Valves at the Frequency of the Vibrating Systems," by Mr. T. G. Hodgkinson; "On the Spectrum of Ionised Tin"; and "On the Spectrum of Doubly Ionised Gallium and Indium," by Mr. K. R. Rao. A demonstration illustrating some Physical Problems connected with Apple Transport will be given by Dr. Ezer Griffiths. 5 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "The Physique of Women Employed in Industry," by Professor E. P. Cathcart. 9 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Room 24, Royal Technical College, Glasgow. Lecture, "Iron and Steel Internationally Considered," by Sir W. J. Larke. 7 p.m.

SATURDAY, JANUARY 29TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South Midland District Meeting at Dunstable. 10.15 a.m.

MONDAY, JANUARY 31ST.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lecture, "Recent Progress in Optics," by Dr. L. C. Martin. 8 p.m.

TUESDAY, FEBRUARY 1ST.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—The Engineers' Club, Waterloo-street, Birmingham. Paper, "Corrosion," by Dr. G. D. Bengough. 7 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. Paper, "Methods of Measuring Temperatures," by Mr. C. E. Pearson. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Joint meeting with the Royal Aeronautical Society. Paper, "Supercharging of Aircraft and Motor Vehicle Engines," by Mr. A. H. R. Fedden. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Coventry Graduates' meeting. Paper, "Magneto Design," by Mr. F. R. Jones. 7.15 p.m.

WEDNESDAY, FEBRUARY 2ND.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Students' meeting. Paper, "Escalator Tunnels and Other Works at Piccadilly-circus," by Mr. J. L. Hunt. 6.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. Informal discussion on "The Purpose and Design of Broadcast Receivers," introduced by Mr. C. F. Phillips. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND CENTRE.—The University, Edmund-street, Birmingham. Wireless Sub-section meeting. Lecture, "Transatlantic Telephony," by Lieut.-Colonel A. G. Lee. 7 p.m.

INSTITUTION OF MINING ENGINEERS.—Institution of Mechanical Engineers, Storey's Gate, Westminster, London, S.W. 1. Annual general meeting. 11 a.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS; MIDDLESBROUGH BRANCH.—Cleveland Scientific and Technical Institution, Corporation-road, Middlesbrough. Graduate Section meeting. "Oil Tankers," by Mr. J. L. Taylor. 7.30 p.m.

THURSDAY, FEBRUARY 3RD.

CHADWICK PUBLIC LECTURES.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Inaugural "Bossom Gift" Lecture, "Developments in Building Methods," by Professor C. H. Reilly. 8 p.m.

CHEMICAL ENGINEERING GROUP.—Chemical Department of the University, Woodland-road, Bristol. Joint meeting with Bristol section. Paper, "The Production of Power from Town's Refuse," by Mr. J. W. Reber. 6.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Paper, "Some Recent Advances in Alternating-current Measuring Insruments," by Lieut.-Colonel K. Edgcumbe and Mr. F. E. J. Ockenden. 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "Acoustical Problems: Æolian Tones," by Sir William Bragg. 5.15 p.m.

FRIDAY, FEBRUARY 4TH.

DIESEL ENGINE USERS ASSOCIATION.—Caxton Hall, Westminster, London, S.W. 1. "The Repair of a Diesel Engine Crank Shaft at the Elander-road Power House of the Karachi Electric Supply Corporation," by Messrs. Handcock and Dykes. Discussion on "Compressed Air Receivers and Proposed Regulations under the Factories (No. 2) Bill," and "Heavy Oil Engine Working Costs, 1925–26." 3 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: NORTH-EASTERN CENTRE.—Hotel Metropole, Leeds. Paper, "The Working of Light Traffic on Railways and the 'Sentinel' Engine," by Mr. J. W. Beaumont. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Engineering Salesmanship," introduced by Mr. W. Reavell. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "The Theory of the Gyroscopic Compass," by Mr. P. R. Jackson. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "Wireless Transmission and the Upper Atmosphere," by Professor E. V. Appleton. 9 p.m.

SATURDAY, FEBRUARY 5TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Grand Hotel, Aytoun-street, Manchester. Lecture, "Early History of the Institute." 4 p.m. Followed by the annual dinner at 6 for 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: WESTERN CENTRE.—Law Courts, Cardiff. Paper, "Maintenance in the United States," by Mr. J. Younger. 6.30 p.m.

MONDAY, FEBRUARY 7TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: WESTERN CENTRE.—Merchant Venturers' Technical College, Bristol. Paper, "Supercharging of Aircraft and Motor Vehicle Engines," by Mr. A. H. R. Fedden. 6.45 p.m.

TUESDAY, FEBRUARY 8TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: COVENTRY CENTRE.—Broadgate Café, Coventry. Paper, "The Supercharging of Aircraft and Motor Vehicle Engines," by Mr. A. H. R. Fedden. 7 p.m.

WEDNESDAY, FEBRUARY 9TH.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND CENTRE.—Birmingham and Midland Institute, Paradise-street, Birmingham. Annual joint meeting with the local branches of the Institutions of Civil and Mechanical Engineers. Faraday lecture, "What is Electricity?" by Professor W. M. Thornton. 7 p.m.

THURSDAY, FEBRUARY 10TH.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Joint meeting with the Electroplaters' and Depositors' Technical Society. "Nickel Coatings—Methods of Production," by Mr. W. R. Barclay. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Midland Hotel, Derby. Derby Graduates' annual dinner and smoking concert. 7.15 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Hotel Cecil, Strand, London, W.C. 2. Annual dinner. 7.15 for 7.45 p.m.

FRIDAY, FEBRUARY 11TH.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Applied Science Department of the University, St. George's-square, Sheffield. "Bronze," by Mr. R. T. Rolfe. 7.30 p.m.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—Metallurgical Department of the University, Singleton Park, Swansea. "The Design of Annealing Furnaces," by Mr. J. S. Caswell. 7.15 p.m.

MONDAY, FEBRUARY 14TH.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—Institution of Engineers and Shipbuilders, 39, Elmbank-crescent, Glasgow. "Notes on Aluminium Alloys," by Mr. D. R. Tullis. 7.30 p.m.

TUESDAY, FEBRUARY 15TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—Municipal College, Ormerod-road, Burnley. Paper, "Strickle Moulding from the Spindle," by Mr. L. Wharton. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: WOLVERHAMPTON CENTRE.—Engineering and Scientific Club, Queen-street, Wolverhampton. Paper, "The Supercharging of Aircraft and Motor Vehicle Engines," by Mr. A. H. R. Fedden. 7.30 p.m.

WEDNESDAY, FEBRUARY 16TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "Some Studies in Connection with the Manufacture of Electric Lamps and Thermionic Valves," by Mr. C. C. Paterson. 8 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are asked to announce that Mr. James Railton, of Messrs. Topham, Jones and Railton, public works contractors, has joined the Board of Stothert and Pitt, Ltd., Bath.

FARADAY MEDAL.—The Council of the Institution of Electrical Engineers has made the sixth award of the Faraday Medal to Professor Elihu Thomson, of Boston, U.S.A., honorary member of the Institution, who is well known as one of the pioneers in the development of electrical engineering. The Faraday Medal is awarded by the Council of the Institution not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science without restriction as regards nationality, country of residence, or membership of the Institution.